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RF ANALYZER
MODEL 640
OPERATION AND MAINTENANCE MANUAL

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RF ANALYZER
MODEL 640
OPERATION AND MAINTENANCE MANUAL

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Applicable Serial Numbers:	
640:	810001 and above
640G50:	913001 and above
640G75:	913001 and above
640E:	914001 and above
640R50:	910001 and above → OR PC BOARD REV. F + ABOVE
640R75:	910001 and above
640T50:	910001 and above
640T75:	911001 and above

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All products are warranted against defects in material and workmanship for one year from the date of shipment (except YIG-tuned oscillators, which have a two-year warranty period). Our obligation covers repairing or replacing products which prove to be defective during the warranty period and which shall be returned with transportation charges prepaid to WILTRON. Obligation is limited to the original purchaser. We are not liable for consequential damages.

MANUAL CHANGES

MODEL 640
OPERATION AND MAINTENANCE MANUAL

Change #1

Serial Numbers Affected

All

A. On page 5-17 in Table 5-4, make the following part number changes:

REF. DES.	DESCRIPTION	WILTRON PART NO.
R33	1M, variable	156-1mA
R34	1M, variable	156-1mA

2 September 1980

Change #2

Serial Numbers Affected

All Instruments

A. In Table 5-2 on page 5-3, add the following WILTRON Part Numbers:

CKT. NO.	NAME & DESCRIPTION	WILTRON PART NO.
C241	CAP., FXD, CER DI:6800PF, +80-20%, 4000V	2000-112
C248	CAP., FXD, CER DI:6800PF, +80-20%, 4000V	2000-112
C249	CAP., FXD, CER DI:6800PF, +80-20%, 4000V	2000-112

18 September 1980

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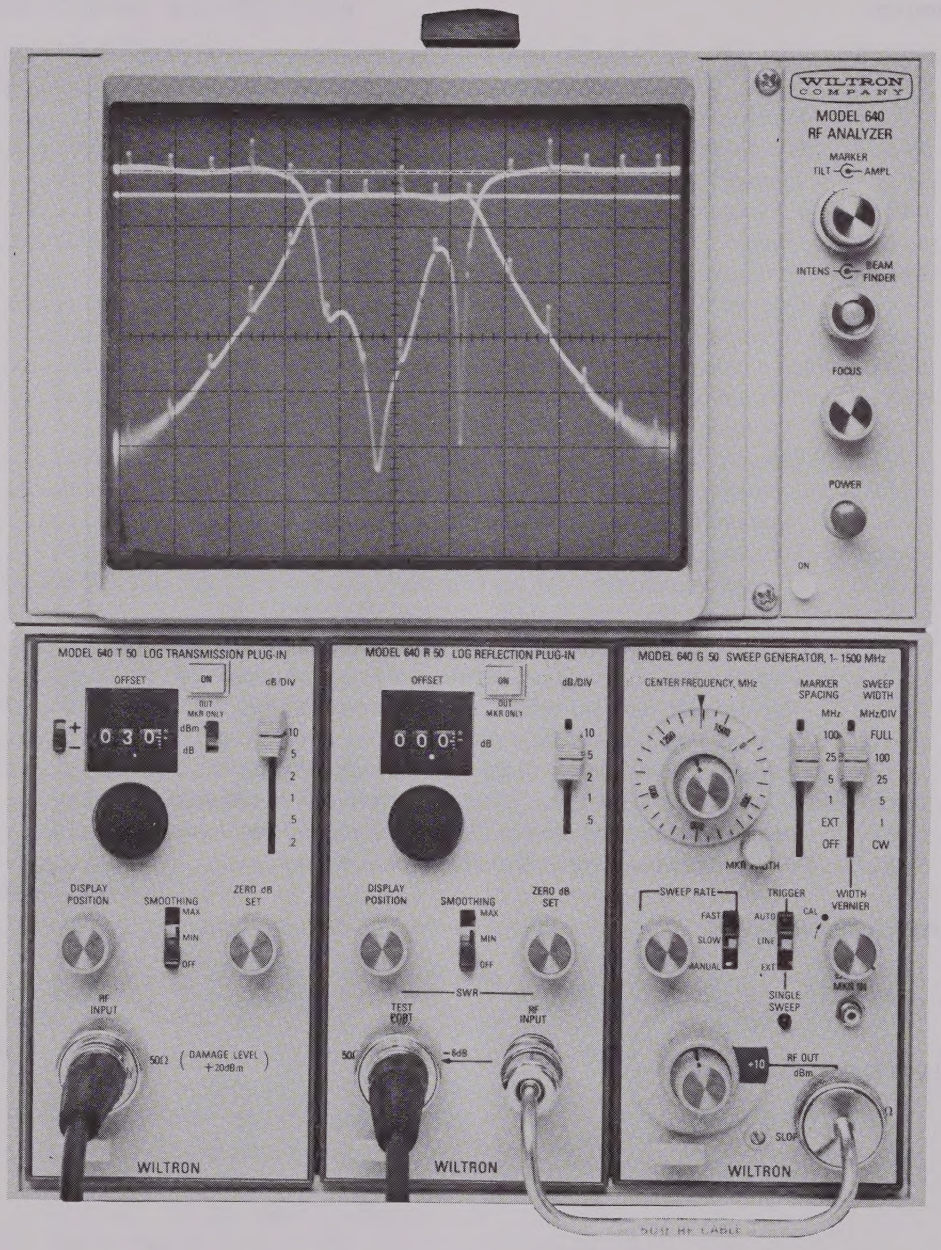


Figure 1-1. WILTRON Model 640 RF Analyzer

SECTION I

GENERAL DESCRIPTION

1-1 INTRODUCTION

This manual contains all information necessary to operate and maintain the WILTRON Model 640 RF Analyzer. A general description of the system, its plug-in units, external accessories and specifications is given in this section. Descriptions of all controls, connectors and indicators, plus detailed operating instructions, are given in Section II. Circuit theory, for the Mainframe and for each plug-in, is presented in Section III. Performance verification and troubleshooting information are given in Section IV. Parts lists and schematics can be found in Sections V and VI respectively.

1-2 SYSTEM DESCRIPTION

The WILTRON Model 640 RF Analyzer, shown in Figure 1-1, is a precision Network Analyzer capable of magnitude (scalar) measurement of transmission (gain or loss) and reflection (return loss or SWR) over a swept frequency range from 1 to 1500 MHz. A special feature of the instrument is its ability to make simultaneous transmission and reflection measurements. It is available in both 50-ohm and 75-ohm versions.

The Mainframe holds 3 plug-in units, and also supplies DC power to both the plug-ins and the front panel CRT display. The large 8 x 10 graticule has 1/2-inch divisions, and is calibrated vertically in dB (gain or loss) and horizontally in MHz (swept frequency). A rear panel BNC connector allows connection of an X-Y recorder for permanent recordings of the measurement parameters.

1-3 PLUG-IN UNITS

The 1-1500 MHz RF Sweep Generator (Model 640G) covers the entire range in one continuous sweep. High signal purity permits accurate measurements. Harmonics are 30 dB down from 5-1500 MHz, and spurious signals are 45 dB below the fundamental at full rated output (10mW). Both sweep width and center frequency are selectable at the front panel. Available widths are 1, 5, 25 or 100 MHz per division, and CW is also available. In addition, crystal markers are provided at 1, 5, 25 and 100 MHz. Marker accuracy is 0.01%, and markers are graduated in height for easy identification. Output power can be adjusted in 10 dB steps from -70 dBm to +10 dBm, and is continuously variable over a 10 dB range. The Log Transmission Plug-In (Model 640T) provides scalar measurement over a 70 dB range. The sensitivity is selectable at 10, 5, 2, 1, 0.5 and 0.2 dB per division. Noise level is typically -60 dBm. Typical drift accuracy is ±0.02 dB/°C. A calibrated digital offset is provided. The plug-in unit can also be used as a power meter, measuring absolute power from -55 to +10 dBm.

The Log Reflection Plug-In (Model 640R) is capable of measuring the match or return loss of the device under test down to -54 dB. Sensitivity is selectable at 10, 5, 2, 1, and 0.5 dB per division, and a digital offset is provided. High accuracy is assured by a built-in directional bridge having a directivity exceeding 40 dB over the full frequency range. The minimum detectable return loss signal is -49 dBm.

In instances where it is not feasible to connect the test device directly to the Model 640 RF Analyzer, the Model 640E Log Amplifier Plug-In and an external directional bridge and RF detector may be used (the configuration is described in paragraph 1-4). This amplifier is of

particular advantage when a large number of different test connectors are required. The scalar measurement range and accuracy are the same as described for the Model 640T and 640R Plug-In units.

If a vertical presentation in linear rather than logarithmic units is required, the Model 640L Plug-In should be used. The linear plug-in gives sensitivities as high as 1 mV/division. The offset is calibrated in mV from 1 to 1,000. As with the Model 640E Log Amplifier Plug-In, an external RF detector and/or directional bridge is required. Figure 1-2 shows all five plug-in units.

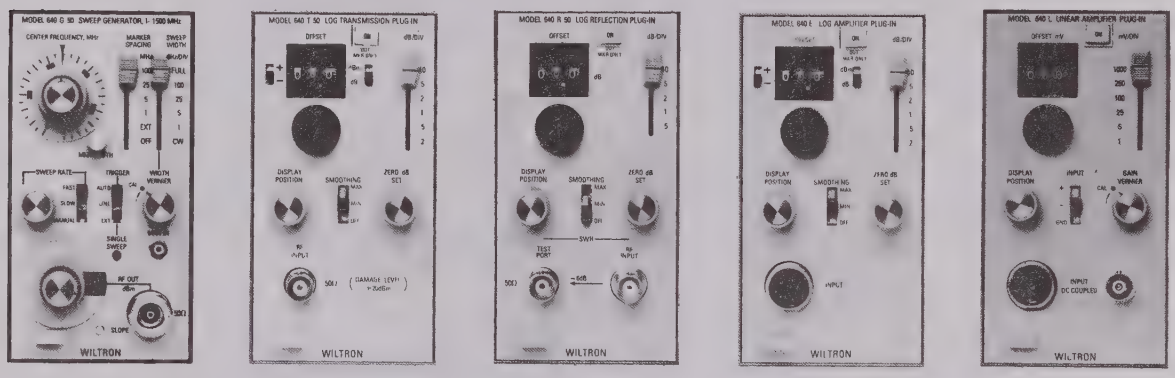


Figure 1-2. Plug-In Units for the Model 640 RF Analyzer

1-4 TYPICAL MEASUREMENT CONFIGURATIONS

Figure 1-3 shows typical measurement setups for simultaneous transmission and reflection measurements. The configuration shown in (A) uses the Model 640G (Sweep Generator), 640R (Reflection), and 640T (Transmission) Plug-Ins. Both transmission and reflection measurements are simultaneously displayed on the CRT and independently controlled. This configuration is ideally suited to testing components (such as bandpass filters) which can be directly connected to the Model 640 RF Analyzer by short low-loss cables.

In instances where it is not feasible to connect the test device directly to the Model 640 Analyzer, the configuration shown in Figure 1-3(B) is used. It consists of the Model 640G Sweep Generator, two Model 640E Log Amplifiers, a Model 6 Series SWR Autotester, and a Model 7 Series RF Detector. The device under test is connected between the SWR Autotester and the RF detector. If simultaneous transmission and reflection measurements are

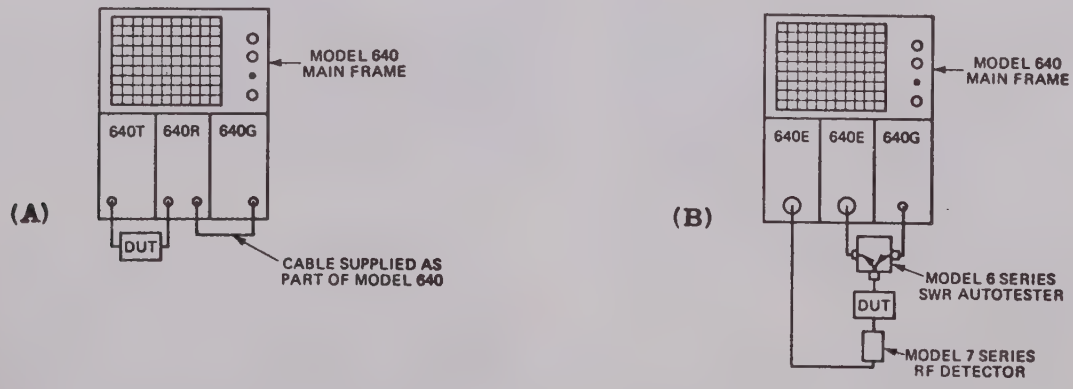


Figure 1-3. Typical Configurations for Insertion Gain/Loss

not required, only one Model 640E Log Amplifier plug-in is needed.

Production testing often uses a reference standard for comparison with the device under test. A typical test configuration is shown in Figure 1-4, and is convenient for high-volume yet accurate testing. A signal divider splits the output of the Model 640G Sweeper into two branches for comparison. The device under test is in one branch, the reference standard in the other. A direct comparison reading is given on the CRT display.

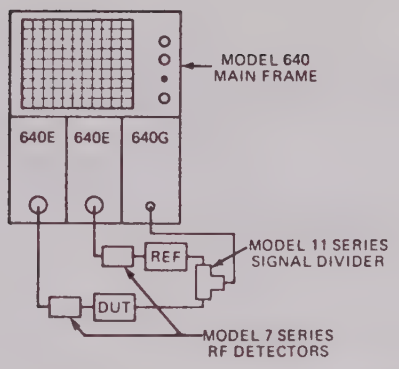


Figure 1-4. Comparison Test Configuration

1-5 APPLICATIONS

The convenience, sensitivity, and accuracy of the Model 640 RF Analyzer make it an ideal choice for a wide variety of measurements. Some of these are described in the following paragraphs.

1-5.1 S-Parameter Magnitude Measurements

The Model 640 can directly produce S-parameter magnitude information. First, the reflection S11 from the input port of the test device and the transmission S21 to the output port are read directly in dB. Then the two connections from the Model 640 to the test device are reversed, and the reflection S22 from the output port and the transmission S12 from output to input are similarly measured.

1-5.2 TV Converter Gain/Loss Measurements

When measuring TV front ends with some broad-band measurement systems, a portion of the local oscillator signal is present, and this causes trouble because it adds to the desired IF signal. This causes the detector output to be erroneously large. Not only is the conversion measurement inaccurate, the shape of the IF response curve appears to change with level (if the detector law is not uniform), and the scope display moves disturbingly if adjustments are made to the LO signal.

In the Model 640 system, the LO signal is not derived from the Model 640G Sweep Generator, so the system excludes it from the display. Converter adjustments thus do not cause any large vertical display shifting (any shifting on the Model 640 display will typically be small and brief).

1-5.3 TV Tuner Image Rejection Measurements

TV tuners for some markets require adjustment for maximum image-frequency rejection. The tests require that the image response be sensed down to levels 75 dB below the desired IF response. Although the required sensitivity is beyond the capabilities of most broad-band instruments, such measurements are easily made with the Model 640.

First, the tuner conversion gain is measured. In a typical image-rejection measurement, the input level must be no higher than -30 dBm. Assuming the conversion gain is typically 20 dB, the IF output level will be -10 dBm, and will be recorded. It should be noted that the noise level of the Model 640 is only 45 dB below this level. To read a signal 75 dB down, the RF input signal to the tuner is increased some 30 dB (to about 0 dBm), using the calibrated Model 640 output attenuator. The increased input level causes the TV converter to limit at the IF frequency, so the response at the image frequency is typically undistorted.

1-5.4 TV Repeater System Measurements

The small size and completeness of the Model 640 as a measuring system make it a natural choice for testing TV repeater systems, especially those in remote locations. A light-weight carrying case (WILTRON Part Number 2000-21) is available for the portable model.

1-5.5 Probing and Signal Tracing

The Model 640 also lends itself to signal tracing and fault location techniques, since it provides both a test signal and a sensitive signal-sensing system. For such use, it is desirable that the 50-ohm input impedance of the Model 640 be increased by the use of probes such as the HP 1002A, or Tektronix P6056 (10X) or P6057 (100X).

1-5.6 Low-Level Amplifier/Mixer Impedance Match Measurements

In a typical case, a signal may be applied to a receiver, amplifier, or mixer at a level of -25 dBm from the Model 640R TEST PORT. The reflection signal is attenuated some 6 dB by the directional SWR Autotester inside the Model 640R. This means that reflections as small as 24 dB (1.13 SWR) can readily be measured (the Model 640 noise level is typically -60 dBm).

For devices accepting applied signals at levels higher than -25 dBm, SWR's below 1.06 can be measured. The limit is set by the 40 dB directivity of the SWR Autotester in the Model 640R Reflection Plug-In.

1-5.7 Cable Testing

The Model 640 is unusually convenient for measuring wideband coaxial cable, since it makes both swept-band reflection and transmission measurements. Coaxial cables are typically tested on the reel by reflection-type measurements. However, since the periodic deformation occurs in a long cable, this means that not only will the reflection be reduced by cable losses, but different values of reflection may be obtained for different signal directions. The ability of the Model 640 to offset (and thus expand) the display sensitivity to as high as 0.2 dB per division is decidedly valuable in making transmission checks for cable defects.

1-5.8 Filter Skirt Depth

The high sensitivity and low spurious output of the Model 640 RF generator permits measuring filter skirts to lower levels than any previous broad-band system. The spurious output of the generator is 50 dB down; the sensitivity is -60 dBm.

In measuring the skirt depth of filters, the filter bandwidth determines the depth to which the skirt can be measured. This occurs because the filter passband passes noise, which is detected by the broad-band detector. So the noise power being passed determines the measurement limit, if that noise power is greater than the -60 dBm sensitivity of the Model 640 system. The following table gives some representative values of measureable skirt depth for various filter bandwidths, with the Model 640 system.

Filter Passband (in MHz)	Minimum Measureable Skirt Depth
1500	50 dB
500	55 dB
100	62 dB
20	>65 dB

1-6 ACCESSORIES AND EXTERNAL COMPONENTS

Table 1-1 lists the complete set of accessories and external components available for the Model 640 RF Analyzer, and identifies those components needed for different system configurations. Figure 1-5 illustrates some selected examples of components.

1-7 SPECIFICATIONS

Table 1-2 lists the major operating and performance specifications for the WILTRON Model 640 RF Analyzer System.

Table 1-1. Accessories and External Components

EXTERNAL COMPONENTS

RF Detectors Exclusively for Model 640

Model	Input Connector	Input Impedance (Ω)
7B50	BNC Male	50
7N50	Type N Male	50
7B75	BNC Male	75
7N75	Type N Male	75

SWR Autotesters Exclusively for Model 640

Model	Test Port Connector	Input Impedance (Ω)	Directivity (dB)
6B50	BNC Male	50	40
6BF50	BNC Female	50	40
6N50	Type N Male	50	40
6NF50	Type N Female	50	40
6B75	BNC Male	75	40
6BF75	BNC Female	75	40
6N75	Type N Male	75	40
6NF75	Type N Female	75	40

Matching Pads

Model	50Ω Connector	75Ω Connector	Max. SWR
12B50/75	BNC Male	BNC Female	1.25
12N50/75	Type N Male	Type N Female	1.25
Insertion Loss: 6 dB nominal.			

Signal Dividers

Model	Connectors	Input Impedance (Ω)	Max. SWR
11B50	BNC Female	50	1.25
11N50	Type N Female	50	1.25
11B75	BNC Female	75	1.25
11N75	Type N Female	75	1.25

Low SWR RF Cables

Model	Both Connectors	Impedance (Ω)	Length Feet	(cm.)	Max. SWR
10B50-1	BNC Male	50	1	(30)	1.1
10B50-2	BNC Male	50	2	(60)	1.1
10B50-3	BNC Male	50	3	(90)	1.1
10N50-1	Type N Male	50	1	(30)	1.1
10N50-2	Type N Male	50	2	(60)	1.1
10N50-3	Type N Male	50	3	(90)	1.1
10B75-1	BNC Male	75	1	(30)	1.13
10B75-2	BNC Male	75	2	(60)	1.13
10B75-3	BNC Male	75	3	(90)	1.13
10N75-1	Type N Male	75	1	(30)	1.13
10N75-2	Type N Male	75	2	(60)	1.13
10N75-3	Type N Male	75	3	(90)	1.13

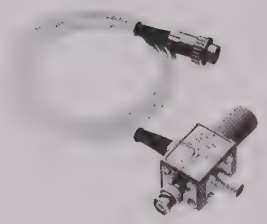
OPTIONS AND ACCESSORIES

Optional Items

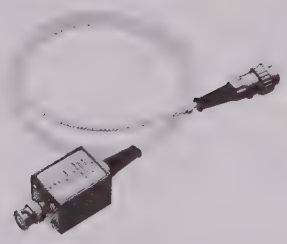
Blank Plug-In Panel, Model 640PI
Option 1: Rack Mounting
Option 2: Pen Lift Contacts
Option 3: Type N Female connectors
Option 4: Protective covers for 640 Mainframe, Front and Rear (cabinet model only)
P/N 2000-21 Fiberglass Carrying Case

Service Accessories

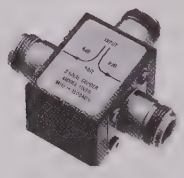
640-ML-5282 Extender Cable for servicing Plug-Ins
Replacement Diode for Model 6 Series
Replacement Diode for Model 7 Series



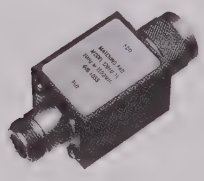
External SWR Autotester (Model 6B50) for use with 640 system when using 640E or 640L plug-ins. Type N and 75-ohm versions also available.



External RF Detector (Model 7B50) for use with 640 system when using 640E or 640L plug-ins. Type N and 75-ohm versions also available.



Signal Divider (Model 11N50) has been designed in versions to fit 50-ohm or 75-ohm systems with type BNC or N connectors.



Matching Pad (Model 12N50/75) to adapt 640 system 50-ohm output to 75 ohms. Type BNC version also available.

Low SWR Cables (Model 10B50-1) for use with 640 system are in 50- and 75-ohm types, in lengths from 1 to 3 feet (30 to 90 cm.) and with BNC or type N connectors.

Figure 1-5. External Components for the Model 640 RF Analyzer

Table 1-2. System Specifications*

RF SWEEP GENERATOR SPECIFICATIONS

FREQUENCY RANGE: 1 MHz to 1500 MHz continuous coverage.

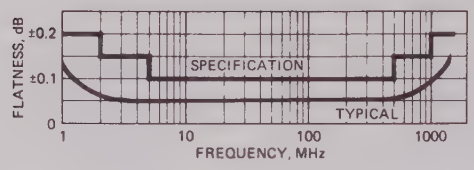
OUTPUT:

Power Level: Adjustable from +10 dBm to -70 dBm; seven 10 dB steps, plus vernier control with >10 dB range.

Step Attenuator Accuracy:

Step	Absolute Accuracy	Incremental Accuracy
10 dB	±0.3 dB	±0.3 dB
20	±0.5 dB	±0.5 dB
30	±0.7 dB	±0.5 dB
40	±0.7 dB	±0.5 dB
50	±0.7 dB	±0.5 dB
60	±0.7 dB	±0.6 dB
70	±0.7 dB	±0.7 dB

Flatness (at 10 dBm):



Slope Adjust: Front panel control with ±2 dB min. adjustment range over full sweep width.

Signal Purity:

Harmonics: >30 dB below rated output 5-1500 MHz, 25 dB typical at 1 MHz.

Spurious: >45 dB below rated output, 50 dB typical

Residual AM: -60 dB in 1 kHz, -40 dB in 1500 MHz bandwidth at +10 dBm.

Residual FM, CW Mode: 7 kHz peak, max. in 28 kHz bandwidth.

External AM: Rear BNC input connector. DC to 5 kHz min. bandwidth.

External FM: Rear BNC input connector. DC to >50 kHz bandwidth (for dev.<5 MHz). 100mV/MHz sensitivity to ±15 V max input voltage.

RF Output Impedance:
Plug-In Model 640G50: 1.35 SWR typ.
Plug-In Model 640G75: 1.35 SWR typ.

RF Output Connector: BNC Female
Option 3: Type N Female

MARKERS:

Spacing: 1, 5, 25, and 100 MHz spacing selectable. 0.01% frequency accuracy, 0.01% spacing accuracy with graduated amplitude.

Width: Variable with front panel control over five to one ratio.

EXTERNAL INPUT:

Frequency range: 10 MHz to 1500 MHz.

Input level: -5 to +5 dBm for best results. +13 dBm max.

FREQUENCY CONTROLS:

Center Frequency: Sets center of sweep width or CW frequency output. Functions as a variable frequency marker when in the full sweep mode.

Sweep Width: Selects full sweep (1-1500 MHz), calibrated sweep widths of 1, 5, 25 and 100 MHz per division, or CW frequency.

Width Vernier: Allows continuous reduction of the 1, 5, 25 and 100 MHz per division sweep widths.

SWEEP RATE:

Fast range: adjustable from approx. 0.02 to 2 seconds.

Slow range: adjustable from approx. 1 to 100 seconds.

Manual: continuous manual scan between frequency settings. The Horizontal Voltage output tracks this manual frequency control.

TRIGGER MODE:

Auto: Sweep occurs automatically.

Line. Sweep automatically synchronized with the power line frequency.

External: Single Sweep is actuated by a front panel pushbutton or external TTL-compatible input on rear panel. Transition to low state or contact closure triggers sweep.

TRANSMISSION MEASUREMENT SPECIFICATIONS

Detector Input Impedance: Plug-In Model 640T50: 50 ohms
Plug-In Model 640T75: 75 ohms

Dynamic Range: >70 dB

Noise Level: -60 dBm typical

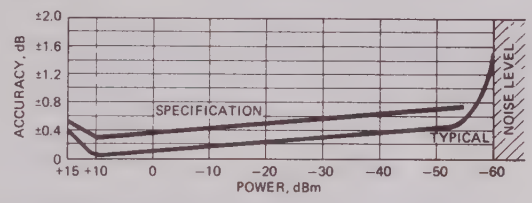
Offset: Calibrated in dB over >±90 dB range

Display Sensitivities: 10, 5, 2, 1, 0.5, 0.2 dB per division

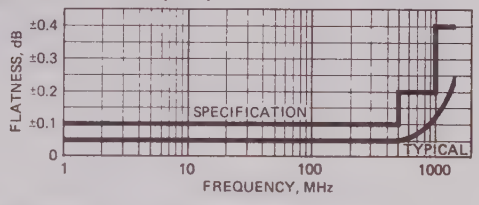
RF Input Connector: BNC Female
Option 3: Type N Female

Smoothing: selectable for noise reduction at low levels

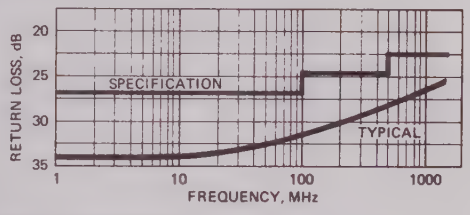
Accuracy: at 25°C, Typical Drift ±0.02 dB/°C to 0° or 50°C



Detector Flatness vs. Frequency:



Detector Return Loss vs. Frequency:



EXTERNAL DETECTORS:

The Model 7 Series meet the above specifications when used with the Model 640E Log Amplifier plug-in. The RF input connector is established by the model of the Detector selected.

REFLECTION MEASUREMENT SPECIFICATIONS

Test Port Impedance:
Plug-In Model 640R50: 50 ohms
Plug-In Model 640R75: 75 ohms

Test Port Signal: +4 dBm or lower

Minimum Detectable Return Loss Signal: -49 dBm

Offset: Calibrated in dB over >±90 dB range

Display Sensitivities: 10, 5, 2, 1, 0.5 dB Return Loss per division

Smoothing: selectable for noise reduction at low levels

Test Port Connector: BNC Female
Option 3: Type N Female

Directivity: 40 dB minimum

EXTERNAL SWR AUTOTESTERS:

The Model 6 Series SWR Autotesters meet the above specifications when used with the Model 640E Log Amplifier plug-in. The test port connector is established by the model of the SWR autotester selected.

LINEAR PLUG-IN SPECIFICATIONS

Maximum input: ±10V

Display Sensitivities: 1000, 250, 100, 25, 5, 1 mV/DIV., plus vernier with >10:1 range

Offset: Calibrated in mV with 1000mV range

Bandwidth: >10 kHz

Polarity: Selectable for positive or negative detectors

Input Connectors: Type BNC for general purpose input, and 5-pin connector for Model 6 and 7 Series External Components.

*After warmup of 30 minutes.

1-8 POWER REQUIREMENTS AND PHYSICAL SPECIFICATIONS

Table 1-2 lists the major operating and performance specifications for the WILTRON Model 640 RF Analyzer system. Dimensions, power requirements, and weight are described below.

POWER REQUIREMENTS: 100, 110, 120, 200, 220, or 240V ac ±10%, internal jumper selected. 48 to 440 Hz.

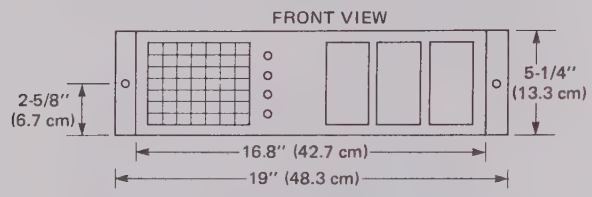
WEIGHT: Approx. 30 lbs. (13.7 kg) (including 3 plug-ins).

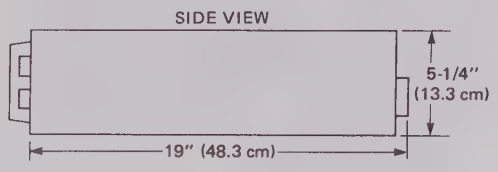
Shipping Weight: Approx. 40 lbs. (18 kg)

DIMENSIONS

Cabinet Model Mainframe: 12" H x 8-1/2" W x 20-1/2" D (30.5 cm H x 21.6 cm W x 52 cm D)

Rack Mounting Dimensions:





1-9 POWER VOLTAGE SELECTION

The power transformer in the Model 640 permits operation from 100V, 110V, 120V, 200V, 220V, and 240V sources, with power line frequencies from 48 to 440 Hz. Use the procedure below to obtain correct instrument operation from the line voltage available.

CAUTION

This instrument is intended for operation from a single-phase, earth-referenced power source having one current-carrying conductor (the Neutral Conductor) near earth potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a three-wire system) is not recommended, since only the Line Conductor has over-current (fuse) protection within the instrument.

Power Voltage Selection Procedure:

1. Disconnect the instrument from the power source.

2. Remove the bottom dust cover of the instrument to gain access to the Power Supply circuit board.

3. To convert from 120 volts to 220 volts nominal line voltage, or vice versa, remove the line-selector block from the square pin connectors (see Fig. 1-6) and replace it with the other block. Remove the line fuse from the fuse holder located on the rear panel of the display module and replace it with one having the correct rating. The unused line-selector block and line fuse can be stored on the Power Supply circuit board. Change the line-cord power plug to match the power source receptacle, or use an adapter.

NOTE

The 120-volt block is color-coded brown, and connects the transformer primary windings in parallel. The 220-volt block is color-coded red, and connects the primary windings in series.

4. To change regulating ranges, place the line-selector block on the desired set of square pins. Select a range which is centered about the average line voltage to which the instrument is to be connected (see Table 1-3).

5. Change the nominal line voltage information on the rear panel of the instrument. Use a non-abrasive eraser to remove the previous data, and mark in the new data with a pencil.

6. Replace the bottom dust cover and apply power to the instrument.

CAUTION

Damage to the instrument may result from incorrect placement of the line-selector block.

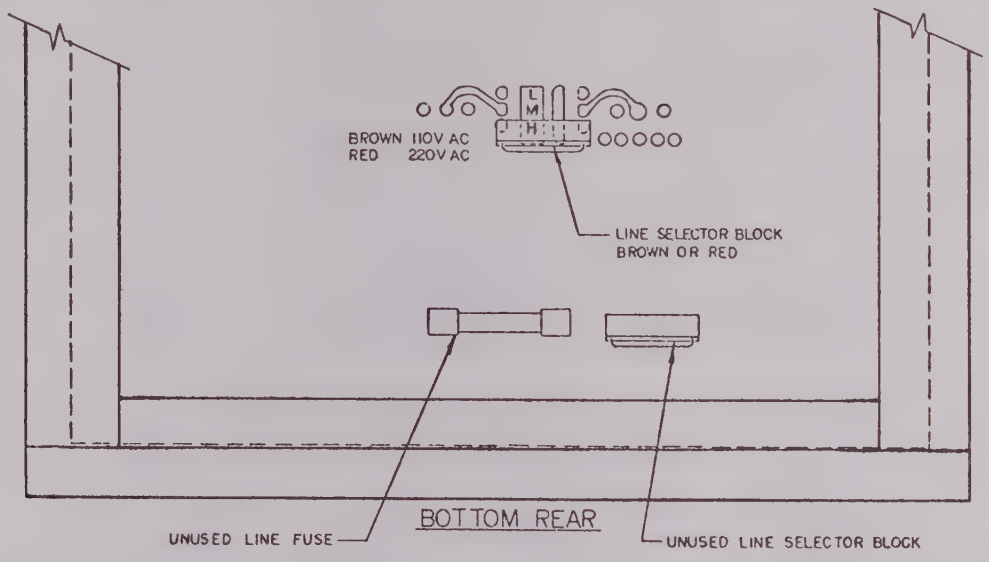


Figure 1-6. Location of Line-Selector Block on Power Supply Circuit Board

Table 1-3. Mainframe Line Transformer Regulating Ranges

LINE SELECTOR BLOCK POSITION	REGULATING RANGES	
	120 VOLTS NOMINAL	220 VOLTS NOMINAL
L	90V ac to 110V ac	180V ac to 220V ac
M	99V ac to 121V ac	198V ac to 242V ac
H	108V ac to 132V ac	216V ac to 264V ac
Line Fuse Data	1.6A slow-blow	1A slow-blow

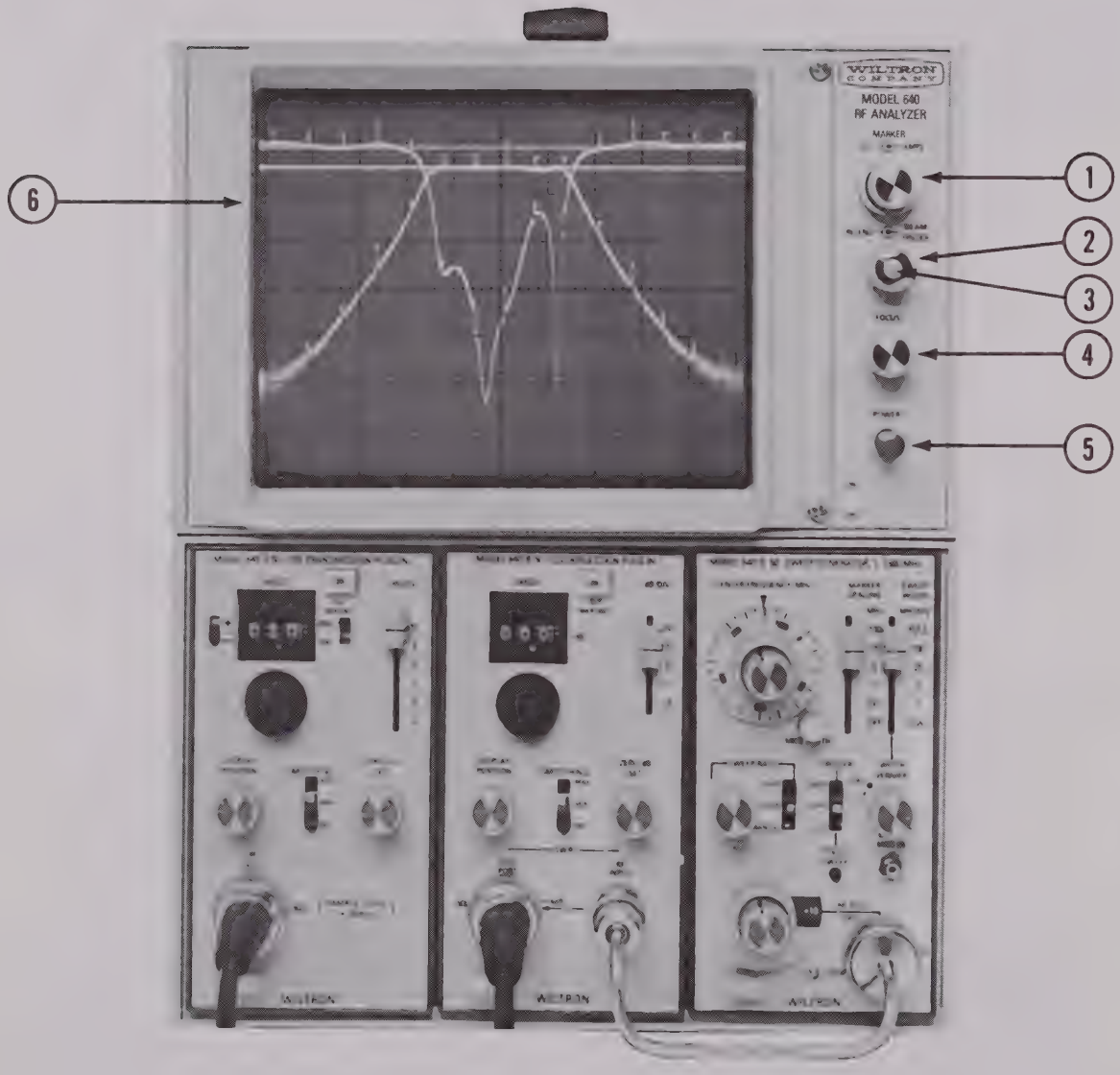


Figure 2-1. Front Panel, WILTRON Model 640
RF Analyzer

SECTION II

OPERATING INSTRUCTIONS

2-1 SCOPE

This section contains descriptions of all controls, connectors, and indicators and their functions. Included are detailed instructions for performing various types of measurements, as well as specific applications and operating hints. This section also contains a list of performance checks, which is used to ensure that all elements in the system are operating properly.

2-2 CONTROLS, INDICATORS AND CONNECTORS

2-2.1 Mainframe, Model 640 (See Fig. 2-1)

(1) MARKER - Outer TILT control adjusts the comb marker and the variable center frequency marker to tilt either to the left or to the right as desired for best visibility. The inner AMPL control adjusts the height of all markers.

(2) INTENS - Adjusts the intensity of the display trace.

(3) BEAM FINDER - Press to find out in which direction beam or retrace is off-screen. Use amplifier DISPLAY POSITION control to return retrace to screen. (If necessary, OFFSET or ZERO dB SET can be used to return main trace.)

(4) FOCUS - Adjusts the focus of the display trace.

(5) POWER - Pull switch out to turn on system power.

(6) CRT DISPLAY - Two measurements are displayed simultaneously on the large 8 x 10 graticule CRT screen with 1/2-inch divisions. The vertical display sensitivity is selectable in calibrated increments of 0.2 to 10 dB per division. Horizontal sensitivity is selectable from 1 to 100 MHz per division, with variable expansion on all but the FULL (0-1500 MHz) range. The return trace is not blanked, but provides a zero reference line for measurements.

2-2.2 Rear Panel Interface Connections (BNC Female Connectors)

HORIZONTAL: 0 to +10V output, which corresponds to 1V per division on the CRT display.

VERTICAL (both channels): -4 to +4V output proportional to the vertical trace on the CRT (1V per division).

EXT AM: Used to amplitude-modulate the RF signal by means of an external input. DC-coupled with a minimum 3 dB bandwidth of 5 kHz.

EXT FM: DC-coupled with a minimum 3 dB bandwidth of 50 kHz. Sensitivity approximately 100mV/MHz ±15V maximum input voltage. Can be used to externally sweep from 1-150 MHz by applying a 0 to 15V ramp. An internal switch (S1) on the sweeper plug-in PC Assembly must be set to the FM position.

EXT TRIGGER: TTL-compatible input which triggers the sweep during a transition from a high to a low signal level. The sweep can also be triggered by a contact closure.

PEN LIFT (Option 2): Provides a contact closure during sweep to automatically drop the pen of an external X-Y recorder when in the slow sweep mode.

2-2.3 Sweep Generator Plug-In, Model 640G (See Fig. 2-2)

(1) CENTER FREQUENCY, MHz - This control works in conjunction with the SWEEP WIDTH, MHz/DIV (switch (9)) control. In any of the calibrated modes, the center frequency control sets the center of the band being swept. In the FULL sweep width mode, this control sets only the position of the variable marker. In the CW mode, this same control sets the frequency of the RF output. It should be noted that for very low-level measurements (i.e. below-35 dBm), one of the swept frequency modes should be used.

(2) MKR WIDTH (Marker Width) - Sets the width of the comb markers for convenient viewing. (The wider marker widths are generally more convenient when wide sweep widths are selected.) In general, a 5:1 ratio is provided.

(3) SWEEP RATE - Slide switch selects FAST, SLOW or MANUAL sweep rate for both RF output and for the CRT display beam.

(4) SWEEP RATE VERNIER - Works as follows for each of the sweep rate settings:

FAST: Varies the sweep rate from approximately 0.02 to 2 seconds.

SLOW: Varies the sweep rate from approximately 1 to 100 seconds.

MANUAL: Provides continous manual adjustment of frequency between the end frequencies. Also provides continuous manual adjustment of display beam, (the horizontal output voltage tracks the manual frequency).

(5) TRIGGER - In the AUTO position, the sweep re-triggers automatically. In the LINE position, the sweep is synchronized with the AC line frequency. In the EXT position, an external signal, applied through the rear panel EXT TRIGGER connector, can start the sweep. Alternatively, in the EXT position, a single sweep is started whenever the SINGLE SWEEP ((12)) pushbutton is pressed.

(6) RF OUT, dBm - Selects RF output level from +10 dBm down to -70 dBm in 10 dB steps. The variable center control provides continuous adjustment below each 10 dB step.

(7) SLOPE - Provides approximately a ±2 dB variation in slope of RF output over the full sweep width (that is, when centered at 750 MHz). Control is used to correct for any slope caused by external cables or other components in the test setup.

(8) MARKER SPACING, MHz - Can be used to select comb markers every 100, 25, 5, or 1 MHz, or to select external (EXT) markers. In the OFF position, the comb markers are not displayed. The markers are graduated in height for easy identification.

(9) SWEEP WIDTH, MHz/DIV. - Selects the frequency bandwidth to be swept. In the FULL position, the complete 1 to 1500 MHz band is swept. For the graduated positions, 100, 25, 5, and 1 MHz per division, the swept bandwidth is centered about the setting of the CENTER FREQUENCY (1) control. For example, if the latter control is set to 200 MHz and the SWEEP WIDTH setting is 5 MHz/DIV., then the frequency band is 50 MHz (5 MHz times the ten divisions on the display) and is swept from 175 to 225 MHz.

(10) WIDTH VERNIER - can be used for continuous expansion of each sweep width, as viewed on the CRT screen.

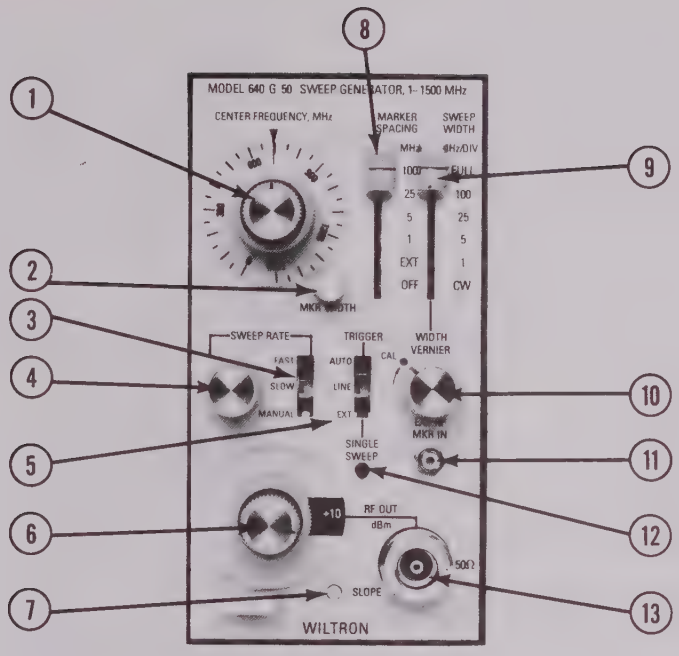


Figure 2-2. WILTRON Sweep Generator Plug-In, Model 640G

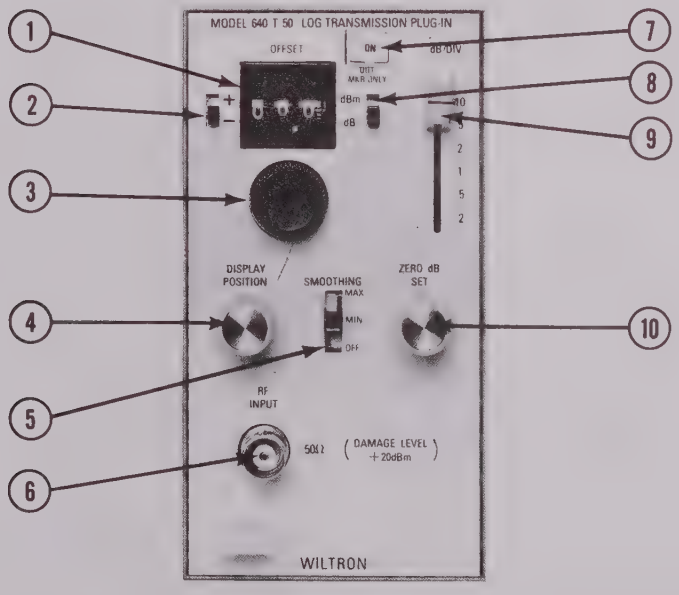


Figure 2-3. Log Transmission Plug-In, Model 640T

(11) EXT RF MKR IN - External reference frequency markers can be applied through this BNC connector. The MARKER SPACING switch ((8)) must be in the EXT position. The signal level is 0 dBm nominal ±5 dBm (into 50 ohms).

(12) SINGLE SWEEP - When the TRIGGER switch ((5)) is in the EXT position, a single sweep can be triggered manually by pressing this pushbutton.

(13) RF Output connector.

2-2.4 Log Amplifier Plug-Ins, Models 640T (Fig. 2-3) and 640E

The Model 640T Log Transmission Plug-In and the Model 640E Log Amplifier Plug-In have almost identical circuitry (except for the built-in detector on the Model 640T), and the controls of the two plug-ins are identical.

(1, 2, 3) OFFSET - Knob and readout provide a calibrated offset that is continuously variable over a greater than 90 dB range. The sign (±) switch selects the polarity of the offset.

(4) DISPLAY POSITION - Adjusts the vertical position of the display trace.

(5) SMOOTHING - Filters reduce the effect of noise when making measurements of low-level signals. Switch has three positions: MAX, MIN, and OFF.

(6) RF INPUT - Input connection for signal to be measured (labeled INPUT on Model 640E). Maximum input signal without damaging the instrument is +20 dBm (100mW).

(7) ON - Press to output the main trace to the CRT. In the OFF position, only the retrace and markers are output to the CRT; (this means the OFF plug-in can be used to provide an adjustable frequency scale, when two plug-ins are used).

(8) dBm/dB - In the dBm position, the ZERO dB SET control (10) is disabled and the display is calibrated in dBm. In this case, the retrace line will correspond to whatever value the OFFSET reads; (if the OFFSET reads 00.0 dB, that is the reference). If the dB/dBm switch is in the dB position, the zero reference is set by the ZERO dB SET control.

(9) dB/DIV. - Selects a display sensitivity of 10, 5, 2, 1, 0.5 or 0.2 dB per division.

(10) ZERO dB SET - Adjusts the measured signal to the level desired to establish a 0 dB reference. This control is disabled when the dBm/dB switch (8) is set to the dBm position.

2-2.5 Log Reflection Plug-In, Model 640R (See Fig. 2-4)

The controls and indicators and their functions are identical to those listed for Models 640T and 640E with the following exceptions: the maximum sensitivity (dB/DIV) is 0.5 dB, controls (2) and (8) have been omitted, and an output port (see Figure 2-4) has been added.

(6) SWR - The TEST PORT connector connects to the device under test. The RF INPUT is connected to the RF Output from the Model 640G Sweep Generator. A semi-rigid cable is supplied for this latter connection. For purposes of identification, the 50-ohm cable and the 75-ohm cable are both clearly labeled. There is a 6 dB difference in the signal level between the RF INPUT and the TEST PORT because of the loss across an internal SWR autotester (SWR bridge).

2-2.6 Linear Amplifier Plug-In, Model 640L (See Fig. 2-5)

The controls and indicators and their functions are identical to those of Models 640T and 640E (Fig. 2-3), with the exceptions noted. This plug-in is provided for applications where the vertical presentation is desired in linear rather than logarithmic units.

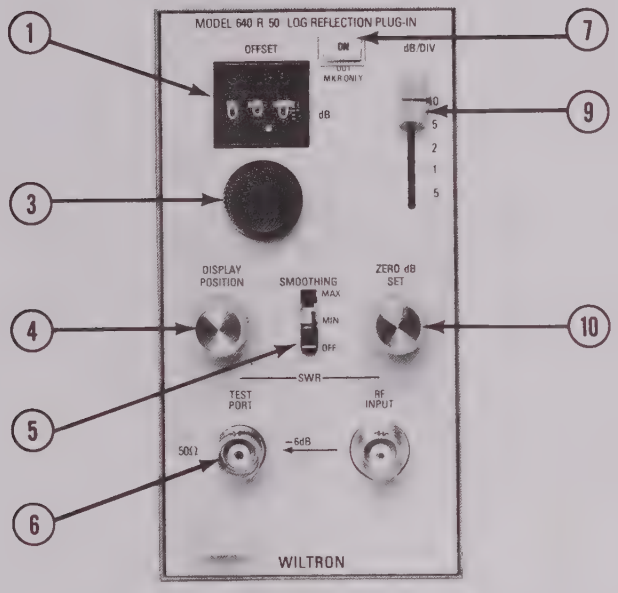


Figure 2-4. Log Reflection Plug-In, Model 640R

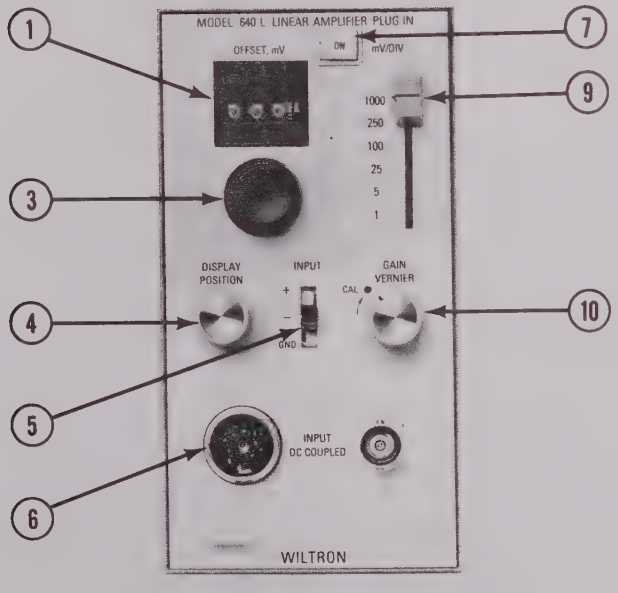


Figure 2-5. Linear Amplifier Plug-In, Model 640L

(1,3) OFFSET mV - Offset is calibrated in millivolts, and is adjustable from 0 to 999 millivolts.

(2) (Omitted)

(6) INPUT DC COUPLED - In general, **any** RF diode detector with positive **or negative** DC output may be used for **input to this** unit. WILTRON units, which provide maximum sensitivity and minimum ground-path pickup and are therefore recommended, connect to the left-hand input. For example, a WILTRON Model 6 SWR Autotester (SWR bridge) is used for reflection measurements; a WILTRON Model 7 RF Detector is used for transmission measurements. The right-hand input is used for other devices having a BNC connector.

(8) (Omitted)

(9) mV/DIV - Selects a display sensitivity of 1000, 250, 100, 25, 5, or 1mV per division.

(10) GAIN VERNIER - When moved from the CAL position, provides an uncalibrated display for convenient viewing. Use of this control does not change the position of the retrace line.

2-3 USING THE SYSTEM

Figure 2-6 provides a block diagram of the Model 640 RF Analyzer to show the measurement techniques utilized and to make clear the function of each amplifier front panel control. The main elements are the mainframe (display) and three plug-in modules. The system always includes the Model 640G sweeper and one amplifier, in addition to the mainframe. With one amplifier, the user may make either transmission or reflection measurements, depending upon the type and configuration. Since the display mainframe has two vertical inputs, the addition of a second amplifier makes it possible to simultaneously display and measure two channels of information.

The system, as shown in Fig. 2-6, is configured for the simultaneous measurement of insertion loss (transmission) and return loss (reflection). Note that no external components are required. The Model 640R (Reflection) amplifier has its own internal SWR bridge and RF detector; the Model 640T (Transmission) amplifier has an internal RF detector. Other configurations are of course possible. For example, two Model 640E log amplifiers may be used. These require external SWR bridges and/or detectors, but would provide a greater physical flexibility for the measuring system's configuration. The choice depends upon the user's requirements.

The Model 640G RF Generator provides the swept RF signal and the sweep ramp; the latter (plus markers) goes to the display unit and provides the horizontal deflection signal. The RF sweep output signal is fed to the RF INPUT of the Model 640R Reflection amplifier, where it is applied to the SWR Autotester. The SWR Autotester is a broad-band reflection bridge with a built-in detector. It presents a forward (transmission) signal at the front panel TEST PORT, while the reflected signal (for the test device) appears at the internal RF detector. The directivity of the SWR Autotester is very high, at least 40 dB over the full 1-1500 MHz band. A DC log conversion amplifier, having a 120 dB dynamic range, completes the reflection measuring equipment.

Both the Model 640T and 640E Plug-Ins use the same internal log amplifier PC assembly. In the Model 640T Transmission Amplifier, the log amplifier is preceded by a wideband RF detector.

2-3.1 The Log Amplifier Plug-In

Figure 2-7 is a detailed block diagram of the log amplifier plug-in, and shows the internal arrangement of controls that enable the operator to set the reference and then measure scalar quantities. The DISPLAY POSITION and ZERO dB SET controls establish the initial horizontal

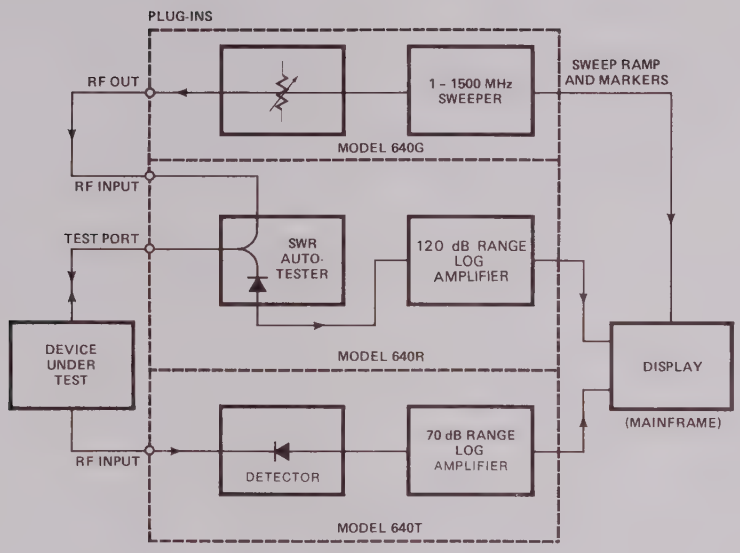


Figure 2-6. Block Diagram, Model 640 RF Analyzer System

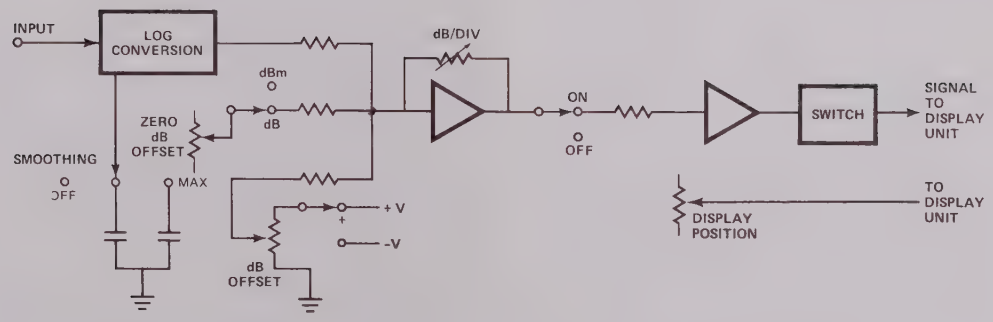


Figure 2-7. Detail, 120 dB Range Log Amplifier Plug-In

reference; the dB/DIV control establishes the scale sensitivity. The plug-in also has a dB OFFSET control, calibrated in tenths of a dB, with a range of ±90 dB. It is useful at low signal levels to bring portions of the swept data onto the screen for viewing with high vertical resolution, while retaining the vertical calibration of the display system.

2-3.2 Typical Measurement Display

Measurement quantities are read directly on the large CRT display, having an 8 x 10 graticule of 1/2-inch divisions. This is considerably larger than most instruments, which use a screen of 8 x 10 cm. Figure 2-8 shows a typical measurement of both insertion loss and return loss for a bandpass filter. Since the sensitivity setting (dB/DIV) was 10 dB per vertical division on the transmission channel, the dynamic range is approximately 60 dB (to the skirts of the filter passband). Note that both insertion loss and return loss are presented directly in dB below the reference line.

2-3.3 Measuring Frequency

The swept band frequencies are read with high accuracy by means of the crystal-controlled markers. These have an accuracy of 0.01%, and the spacing is selectable at 1, 5, 25 and 100 MHz. The markers for different frequencies are easily identified, as they are graduated in height in a 1:1, 2:1, 3:1 and 4:1 sequence. This is illustrated in Figure 2-9, which shows the appearance when all four markers are on. In Figure 2-8 the marker spacing is 1 MHz and the calibrated sweep is set at 1 MHz per division. The 5 MHz markers are easily identifiable. These markers can also be tilted (up to ±45°) for ease in identification on a steep-slope portion of the trace.

Figure 2-10 shows another convenient feature of the Model 640 RF Analyzer: If the amplifier for one channel is turned off, the frequency markers continue to appear and provide an easy-to-read reference for the "on" channel.

The RF generator provides a full-band sweep from 1 to 1500 MHz (identified on the Model 640G front panel as FULL), plus four calibrated higher-resolution sweep ranges of 100, 25, 5 and 1 MHz per division. These latter ranges are centered about whatever frequency the operator has selected.

Figure 2-11 illustrates the ease with which the operator can select a frequency of interest, then switch to one of the calibrated ranges to expand the display about that point. In 2-11(A) the operator has selected FULL (1 to 1500 MHz) and then used the CENTER FREQUENCY to place a variable marker at 900 MHz. In 2-11(B) he has switched to a sweep width of 25 MHz per division and a marker spacing of 100 MHz. The 900 MHz marker is now centered on the display.

Figure 2-11(C) illustrates the frequency range if any of the 4 calibrated ranges had been selected. The variable marker does not appear when one of the calibrated high-resolution sweep ranges is selected.

In summary, the Model 640 RF Analyzer is easy and convenient to use. In most instances, the setup is extremely simple since the system contains all needed measuring elements. After establishing a zero reference level, it is only necessary to connect the test device to the input and output of the analyzer. The performance characteristics are then read directly on the screen, or from the front panel control settings. The parameters of interest (which can be read directly) include swept frequency range, applied RF power, transmission, and the frequency limits of the device under test.

In general, once the system has been set up and the reference levels established, a number of devices can be measured without further adjustments.

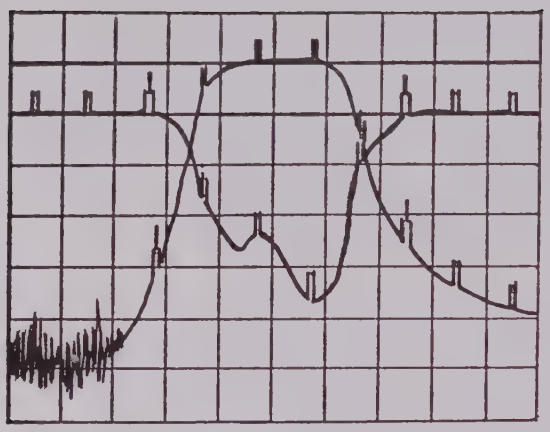
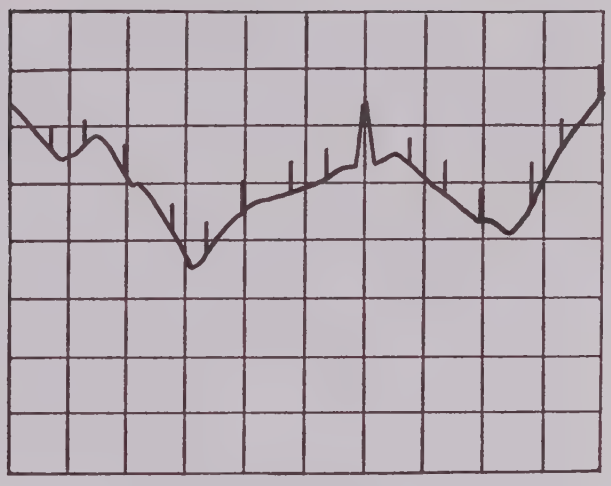


Figure 2-8. Typical Measurement Traces



(A) Full Width

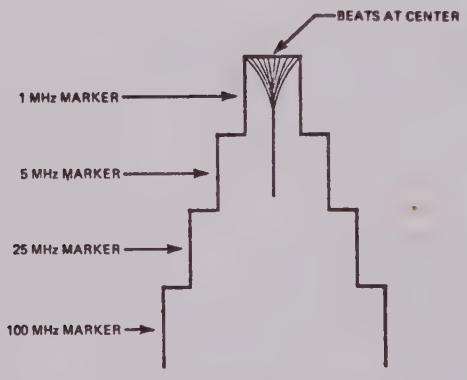
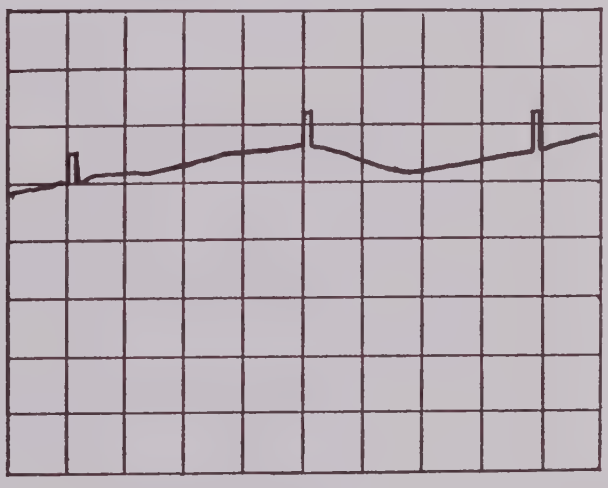


Figure 2-9. Frequency Marker Arrangement



(B) 25 MHz per Division (100 MHz Markers)

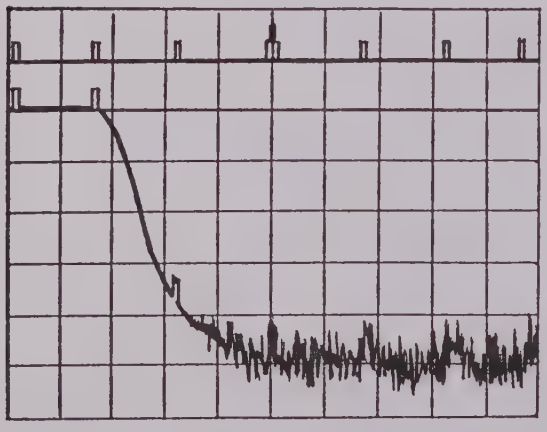
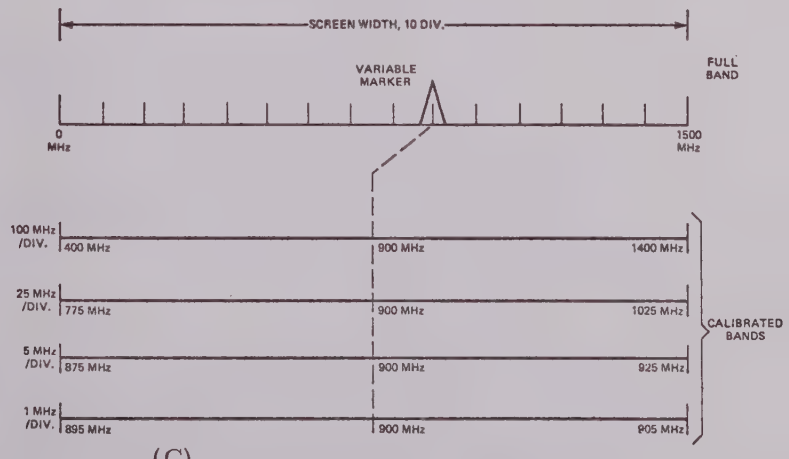


Figure 2-10. Using the "Off" Channel to Identify Markers



(C)

Figure 2-11. Selecting Center Frequency and Sweep Width

2-4 OPERATING INSTRUCTIONS

The following tables contain detailed instructions for initializing and operating the system.

Table 2-1 describes the procedure for preliminary setup, followed by instructions for setting the zero reference lines on both channels. The procedure applies specifically to a configuration such as that shown in Figure 2-6 using the Model 640R and 640T Log Amplifiers, but the instructions are general enough (with minor differences) to apply to other amplifiers and other system configurations. This table is intended to assist the operator who is using the system for the first time.

Paragraph 2-4.1 describes in detail the procedure for making simultaneous transmission and reflection measurements on a bandpass filter, where the exact frequency is not known in advance. This example is intended primarily to assist a new operator in becoming familiar with the use of the RF Analyzer system.

Paragraphs 2-4.2 through 2-4.4 contain operating instructions for different system configurations, using all types of amplifiers.

Paragraph 2-4.5 gives operating hints and precautions.

Table 2-1. Initialization

A. PRELIMINARY SET-UP

1. Model 640G Sweep Generator

CENTER FREQUENCY:	0 MHz
Vernier:	Straight up
MARKER SPACING:	100 MHz
SWEEP WIDTH:	FULL
WIDTH VERNIER:	CAL
SWEEP RATE:	FAST
Vernier:	Clockwise
TRIGGER:	AUTO
RF OUT:	0 dBm
Vernier:	3 o'clock position

Connect a rigid cable from RF OUTPUT of the Model 640G to RF INPUT of the Model 640R Amplifier.*

2. Model 640R and 640T Log Amplifiers*

ON Switch:	OFF (Out)
OFFSET:	00.0 dB
dBm/dB:	dB (Model 640T only)
dB/DIV:	10
SMOOTHING:	OFF

*If the system uses Model 640E amplifiers, see the configuration and test procedure in paragraph 2-4.3.

Table 2-1. Initialization (Continued)

b. SETTING ZERO REFERENCES

1. Mainframe

POWER:	ON (Pull Out)
INTENS:	As desired
FOCUS:	As desired
MARKER:	
TILT:	Adjust for vertical
AMPL:	Fully clockwise

2. Model 640R and 640T Log Amplifiers

DISPLAY POSITION:	Adjust so reference traces are about 3 vertical divisions apart and near the center (see Fig. 2-12)

Make sure that no cables or devices are connected to the TEST PORT of the Model 640R Amplifier.

ON switch (Model 640R only):	ON (push in)
ZERO dB SET (Model 640R only)	Adjust so trace (with markers) falls on zero reference line (see Fig. 2-12)*

THE MODEL 640R AMPLIFIER IS NOW CALIBRATED.

Turn OFF the Model 640R amplifier.

Connect a short cable from the TEST PORT (Model 640R) to the RF INPUT (Model 640T).

ON switch (Model 640T only):	ON (push in)
ZERO dB SET (Model 640T only):	Adjust so trace falls on zero reference line

THE MODEL 640T AMPLIFIER IS NOW CALIBRATED.

ON switch (Model 640R)	ON (push in)
DISPLAY POSITION: }	Adjust as desired to establish reference lines. (If a loss is expected, set lines near top of display and set OFFSET on Model 640T to -.)
OFFSET: }	

THE 640 SYSTEM IS NOW CALIBRATED AND READY TO MAKE MEASUREMENTS.

*For purposes of discussion, we have separated the two reference traces. In actual use, the operator may prefer to have both references on the same graticule line.

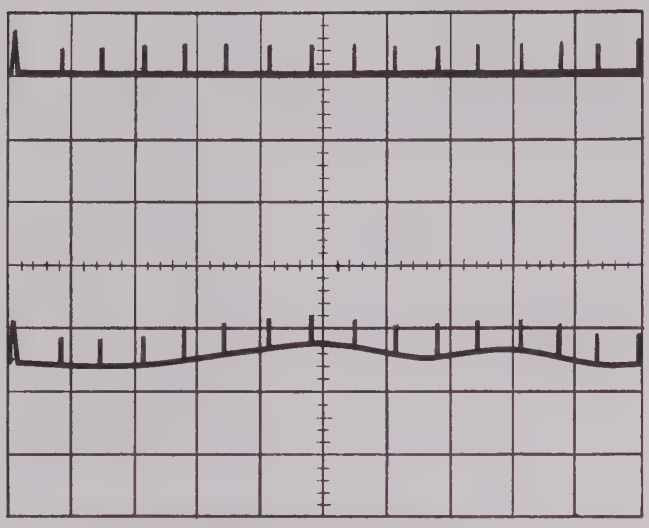
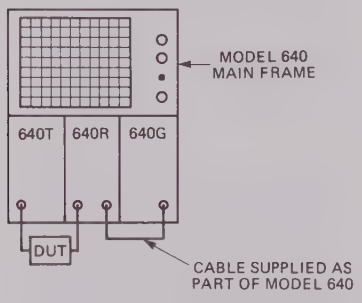


Figure 2-12. Setting the Zero dB Reference

2-4.1 Example Measurement



1. Complete the initialization of the system (Table 2-1).
2. Connect test bandpass filter as shown above.
3. Turn off Log Reflection Amplifier (Model 640R).
4. Make sure SWEEP WIDTH control (Model 640G) is set to FULL.
5. Identify the fundamental response of the filter (see Fig. 2-13), and set CENTER FREQUENCY control (Model 640G) so that marker is exactly aligned to peak.

NOTE

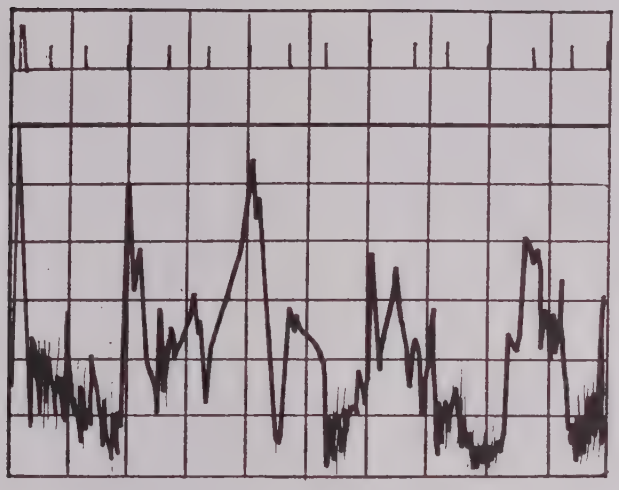
In the example shown in Fig. 2-13A, the fundamental is approximately 30 MHz.

6. Select a calibrated SWEEP WIDTH (Model 640G) approximately equal to the bandpass of the filter.

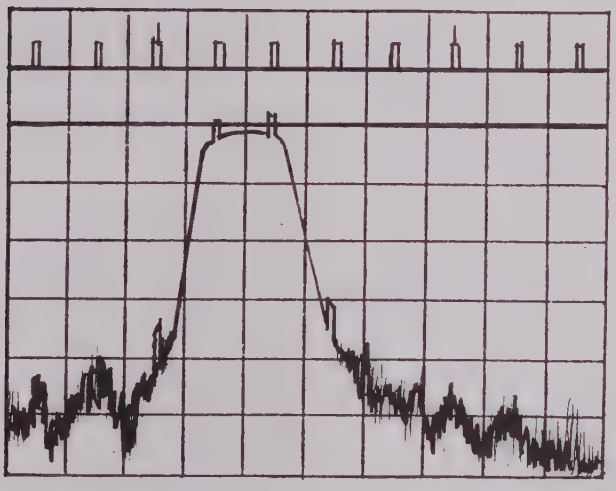
NOTE

In the example in Fig. 2-13B, the bandwidth of the filter is approx. 5 MHz.

7. Use the vernier on the CENTER FREQUENCY control (Model 640G) to center the trace, and WIDTH VERNIER to expand the trace as desired. Select MARKER SPACING as required for reading frequency. Adjust MARKER TILT if necessary.
8. Turn on the Model 640R Log Amplifier. Adjust the dB/DIV controls on both amplifiers for desired sensitivity.
9. Read return loss and insertion loss directly on the calibrated display.



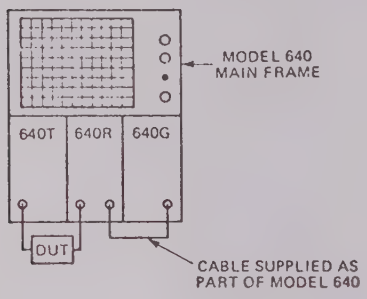
(A) Display Presentation for FULL Sweep



(B) Display Presentation for 5 MHz/DIV Sweep

Figure 2-13. Example Measurement, Bandpass Filter

2-4.2 Simultaneous Transmission and Reflection Measurements Using the Model 640R and 640T Log Amplifier Plug-Ins



1. Connect the power plug to the AC power source. Pull out the POWER switch to turn on the system power.
2. Set the INTENS and FOCUS controls for the desired brightness and focus.
3. Set the CENTER FREQUENCY control on the Sweep Generator plug-in for the center frequency required for the test.
4. Set the SWEEP WIDTH and WIDTH VERNIER controls for the sweep width to be used for the test.
5. Set the SWEEP RATE and TRIGGER switches for the type of display required.
6. Set the RF OUT step attenuator for the appropriate test level in dBm.
7. Set the ON switch at the top of the Model 640R to the ON position (push in).
8. On the Model 640T and 640R plug-ins, set the OFFSET +/- switches to -.

NOTE

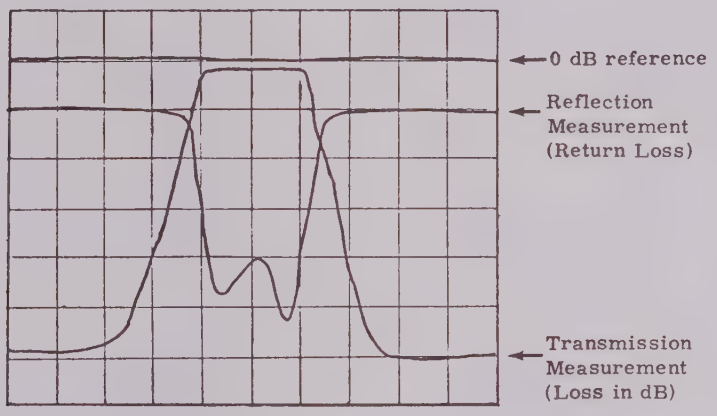
If the device under test is an active type, a transmission gain may be measured. In this case, set the OFFSET + - switch on the Log Transmission Plug-In to + .

9. Set the OFFSET controls on the Log Transmission and Reflection plug-ins to 00.0 .
10. Adjust the DISPLAY POSITION controls on the Log Transmission and Log Reflection Plug-Ins to establish reference lines at the desired position on the display. The center of the screen is usually used if it is not known whether a gain or loss will be measured. If a transmission loss and a return loss are expected to be measured, place the reference lines near the top of the display.
11. Attach the semi-rigid cable supplied with the system to the RF OUT connector on the Sweep Generator Plug-In, and the RF INPUT connector on the Log. Reflection Plug-In.
12. Ensure that there is no connection made to the TEST PORT connector on the Log Reflection Plug-In. This establishes a reference for 0 dB return loss. Adjust the ZERO dB SET control on the Log Reflection Plug-In so that the trace is coincident with the reflection reference line set in step 10. Turn off the Model 640R amplifier, and turn on the Model 640T.
13. Connect a short cable from the TEST PORT connector on the Log Reflection Plug-In to the RF INPUT connector on the Log Transmission Plug-In. This establishes a reference for 0 dB transmission loss or gain. Adjust the ZERO dB SET control on the Log Transmission Plug-In so that the trace is coincident with the transmission reference line set in step 10. Disconnect the cable.
14. Connect the input of the device under test to the TEST PORT connector on the Log Reflection Plug-In. Connect the output of the device under test to the RF INPUT connector on the Log Transmission Plug-In. Turn the Model 640R amplifier on again.
15. Check if a readable display is obtained for both transmission and return loss. If not, set the dB/DIV switches on each

plug-in so that the transmission and return loss displays occupy most of the graticule, as shown in the example in Figure 2-14.

16. Read the transmission loss (or gain) and the return loss in dB of the device under test by multiplying the number of graticule divisions by the dB/DIV setting. Figure 2-14 shows the transmission loss and return loss of a typical bandpass filter.

17. If frequency markers are desired, set the MARKER SPACING and MKR WIDTH controls on the Sweep Generator Plug-In for the reference required. Use the main frame MARKER TILT and AMPL controls to obtain optimum markers.



Example:

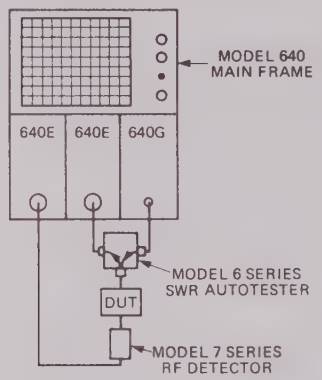
Transmission: 5 dB/DIV = approx. 1 dB loss in the center of the passband, and 30 dB loss outside the passband.

Reflection: 5 dB/DIV = approx. 20 to 26 dB return loss in the passband, and 5 dB return loss outside the passband.

Figure 2-14. Typical Transmission Loss and Return Loss Display for Measurement of a Bandpass Filter

2-4.3 Simultaneous Transmission and Reflection Measurements Using Two Model 640E Log Amplifier Plug-Ins

An external WILTRON Model 6 Series Autotester and Model 7 Series RF Detector can be used with the Model 640 for test setups where the device under test cannot be conveniently connected to the front panel. In this test setup, the WILTRON Model 6 Series Autotester and Model 7 Series RF Detector are used in conjunction with two Model 640E Log Amplifier Plug-Ins.



Test Setup for Using an External Autotester and RF Detector

1. Connect the power plug to the AC power source. Pull the POWER switch out to turn on the system power.
2. Set the INTENS and FOCUS controls for the desired brightness and focus.
3. Set the CENTER FREQUENCY control for the center frequency required for the test.
4. Set the SWEEP WIDTH control for the sweep width required for the test device.
5. Set the SWEEP RATE and TRIGGER controls for the type of display desired.
6. Set the RF OUT step attenuator for the appropriate signal level in dBm.
7. Set the OFFSET controls on both log amplifiers to 00.0 dB. Set the OFFSET +/- control on the transmission channel amplifier to - for expected loss, to + for expected gain.
8. Adjust the DISPLAY POSITION controls on both log plug-ins to establish reference lines on the display. If a loss is expected, place the reference lines near top of the display.
9. Connect an SWR autotester (or SWR bridge and RF detector) to Model 640G and 640E Plug-Ins (see diagrams).

NOTE

DO NOT ATTACH TEST DEVICE TO TEST PORT OF BRIDGE OR SWR AUTOTESTER. TEST PORT MUST BE OPEN TO ESTABLISH a 0 dB REFERENCE.

10. Turn ON the log reflection amplifier plug-in. Adjust the ZERO dB SET control so that the trace is aligned with the reference established in step 8.
11. Turn OFF the log reflection plug-in amplifier. Turn ON the log transmission plug-in amplifier.
12. Connect a Model 7 Series RF Detector to the input of the log transmission plug-in. Connect a short cable from TEST PORT of SWR Autotester (or SWR Bridge) to input of RF detector.
13. Adjust the ZERO dB SET control on the log transmission plug-in to make trace coincident with the reference line established in step 8.
14. Disconnect cable; connect the test device between TEST PORT of SWR Autotester (or SWR Bridge) and input of RF detector.
15. Check if a readable display is obtained. If not, set the dB/DIV and OFFSET controls as required. Read the transmission loss or gain directly on the display. (See Figure 2-14 for example.)
16. Turn ON the log reflection plug-in amplifier. Set dB/DIV and OFFSET controls as desired.
17. To read frequency, set the MARKER SPACING controls as desired. The CENTER FREQUENCY VERNIER and sweep WIDTH VERNIER controls can

be used to center the response, and to expand the display respectively.

18. Adjust MARKER TILT and AMPL controls as desired.

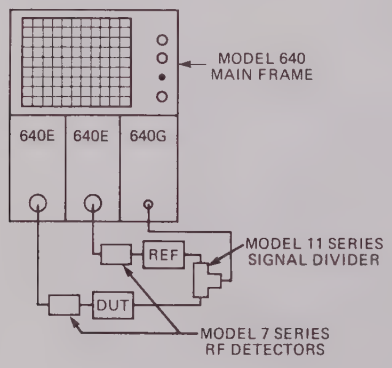
NOTE

If user is making only reflection measurements, be sure to terminate the output of the test device. Otherwise, inaccurate measurements will result.

2-4.4 Measurements Made to a Reference Standard, Using Two Model 640E or 640T Log Amplifier Plug-Ins

The transmission response of a test device can be compared to the response of a reference standard, using the test configuration shown. The WILTRON Model 11 Series Signal Divider is used with two Model 7 Series RF Detectors and two Model 640E Log Amplifiers.

An alternate configuration would use two Model 640T Log Transmission Plug-Ins. The external RF Detectors are then omitted, since these are incorporated into the Model 640T Plug-In.



1. Connect the power plug to the AC power source. Pull the POWER switch out to turn on the system power.
2. Set the INTENS and FOCUS controls for the desired brightness and focus.
3. Set the CENTER FREQUENCY control for the center frequency required for the test.
4. Set the SWEEP WIDTH control for the sweep width required for the test device.
5. Set the SWEEP RATE and TRIGGER controls for the type of display desired.
6. Set the RF OUT step attenuator for the appropriate signal level in dBm.
7. Set the OFFSET controls on both plug-ins to 00.0 dB. Set the OFFSET + - control to - if a loss is expected, or to + if a gain is expected.
8. Adjust the DISPLAY POSITION controls on both log plug-ins to establish reference lines on the display. For a loss, place the reference lines near the top of the display.
9. Connect a WILTRON Model 11 Series Signal Divider to Model 640G sweeper. Connect outputs of signal divider to Model 7 Series RF Detectors (see configuration drawing).

NOTE

If Model 640T Log Transmission Plug-Ins are used instead of Model 640E Amplifiers, the RF detectors are not used.

10. Connect short cables from RF detectors to inputs of log plug-ins.
11. Turn on both plug-ins (ON switch pressed in). Adjust the ZERO dB SET control on each plug-in to make trace coincident with the reference line established in step 8.
12. Disconnect cables and connect reference standard between RF detector and divider in one channel, and test device in other channel.
13. Check if a readable display is obtained. If not, set the dB/DIV and OFFSET controls on both amplifiers. Read the relative gain or loss directly on the display.
14. To read frequency, set the MARKER SPACING controls as desired. The CENTER FREQUENCY vernier and sweep WIDTH VERNIER can be used to center the response curve and to expand the display as desired.

15. Adjust MARKER TILT and AMPL controls as desired.

16. The system is now ready to compare a sequence of test devices against the standard.

2-4.5 Operating Hints

Power Readings

a. When making an absolute power reading, the dB/dBm switch on the log amplifier must be in the dBm position. This disables the ZERO dB SET control. To establish the reference level for the display trace, it is only necessary to set the DISPLAY POSITION control.

b. If the display trace if off-scale, use the OFFSET +/- control and the calibrated OFFSET dB control to bring the trace back onto the display.

RF Sweep Output Level

For an absolute output, connect the RF output of the sweep generator to the log transmission input, then read the absolute power level in dBm while adjusting the RF OUT vernier.

The relative accuracy of each setting of the 70 dB step attenuator on the sweep generator varies from ±0.3 dB (on the 10 dB step) to ±0.7 dB (on the 70 dB step).

Terminations

When making reflection measurements only, be sure to terminate the output of the test device in the characteristic impedance.

When making transmission measurements with a Model 11 Series Signal Divider, if only one channel is used, be sure to properly terminate the other output of the divider.

Beam Finder

In some instances, the BEAM FINDER control may be quicker than the OFFSET +/- and OFFSET dB controls in determining the direction in which a trace is off-screen.

Table 2-2. Return Loss - SWR - Reflection Coefficient Conversion Chart

Return Loss dB	SWR	Reflection Coefficient	Return Loss dB	SWR	Reflection Coefficient
1	17.3910	.8913	31	1.0580	.0282
2	8.7242	.7943	32	1.0515	.0251
3	5.8480	.7079	33	1.0458	.0224
4	4.4194	.6310	34	1.0407	.0200
5	3.5698	.5623	35	1.0362	.0178
6	3.0095	.5012	36	1.0322	.0158
7	2.6146	.4467	37	1.0287	.0141
8	2.3229	.3981	38	1.0255	.0126
9	2.0999	.3548	39	1.0227	.0112
10	1.9250	.3162	40	1.0202	.0100
11	1.7849	.2818	41	1.0180	.0089
12	1.6709	.2512	42	1.0160	.0079
13	1.5769	.2239	43	1.0143	.0071
14	1.4985	.1995	44	1.0127	.0063
15	1.4326	.1778	45	1.0113	.0056
16	1.3767	.1585	46	1.0101	.0050
17	1.3290	.1413	47	1.0090	.0045
18	1.2880	.1259	48	1.0080	.0040
19	1.2528	.1122	49	1.0071	.0035
20	1.2222	.1000	50	1.0063	.0032
21	1.1957	.0891	51	1.0057	.0028
22	1.1726	.0794	52	1.0050	.0025
23	1.1524	.0708	53	1.0045	.0022
24	1.1347	.0631	54	1.0040	.0020
25	1.1192	.0562	55	1.0036	.0018
26	1.1055	.0501	56	1.0032	.0016
27	1.0935	.0447	57	1.0028	.0014
28	1.0829	.0398	58	1.0025	.0013
29	1.0736	.0355	59	1.0022	.0011
30	1.0653	.0316	60	1.0020	.0010

SECTION III
FUNCTIONAL DESCRIPTION

3-1 INTRODUCTION

This section presents a block-level circuit description of the Model 640 RF Analyzer.

3-2 SYSTEM BLOCK DIAGRAM

As shown in Figure 3-1, the 640 RF Analyzer consists of the following: 640 Mainframe, 640G Sweep Generator Plug-In, 640R Log Reflection Plug-In, and 640T Log Transmission Plug-In. Because the log plug-ins all operate in a similar manner, they are all described in paragraph 3-4, while the 640L Linear Plug-In is described in paragraph 3-5.

3-2.1 Mainframe

The 640 Mainframe houses the plug-in units and contains the CRT that displays data from simultaneous transmission loss/gain and reflection measurements from the log and/or linear plug-ins.

3-2.2 Sweep Generator

The sweep generator provides swept or fixed-frequency RF output for the device under test and the CRT horizontal deflection ramp. The Ramp Generator section generates the ramp and sends it to the Frequency Instruction section, where the operator selects full or narrow sweep or CW mode. When narrow sweep or CW mode is selected, the CENTER FREQUENCY, MHz control determines the center frequency of the sweep. Regardless of the position of the SWEEP WIDTH switch, either a full (0 to +10V) or variable ramp is sent to the Linearizer section, while a full ramp is sent to the mainframe Horizontal Deflection Amplifier via the 640G Horizontal Deflection section. The frequency instruction ramp is sent to the Linearizer section that modifies the ramp and sends it to the RF Section to produce a linear-frequency RF output. The setting of the RF OUT vernier determines the RF Section power output. The vernier adjusts the ALC level correction signal, which determines the RF Section output level. The detected sample, which acts as a feedback signal, is summed with the level correction signal to provide a constant RF output level. The RF Output is sent to the 640R RF INPUT via the 0-70 dB Attenuator. At the same time, a portion of the RF output is sent to the Marker Section, where the RF output is heterodyned with a crystal marker signal to produce four selectable harmonic markers. The Marker Section output is then sent to the log plug-in Marker Input.

3-2.3 Log Reflection Plug-In

The log reflection plug-in measures the return loss of a device under test (DUT) when it is connected to the test port of the plug-in. The RF output from the 640G is applied to the SWR Autotester through the log plug-in RF INPUT (Figure 3-1). The RF signal is then sent to the DUT through the test port of the SWR Autotester. A portion of the RF signal is then reflected back to the test port. The amount of signal reflection depends upon the impedance match between the test port and the DUT. This reflected RF signal is then detected by the detector in the SWR Autotester. The Log Amplifier converts the detected signal to a logarithmic voltage that is sent to the mainframe Vertical Input. The dB/DIV switch changes the vertical sensitivity of the log plug-in output, while the OFFSET, ZERO dB SET, and DISPLAY POSITION controls position the RF trace and retrace anywhere on the CRT display at any vertical sensitivity setting. The markers from the 640G are routed via the Marker Summing amplifier to the CRT display.

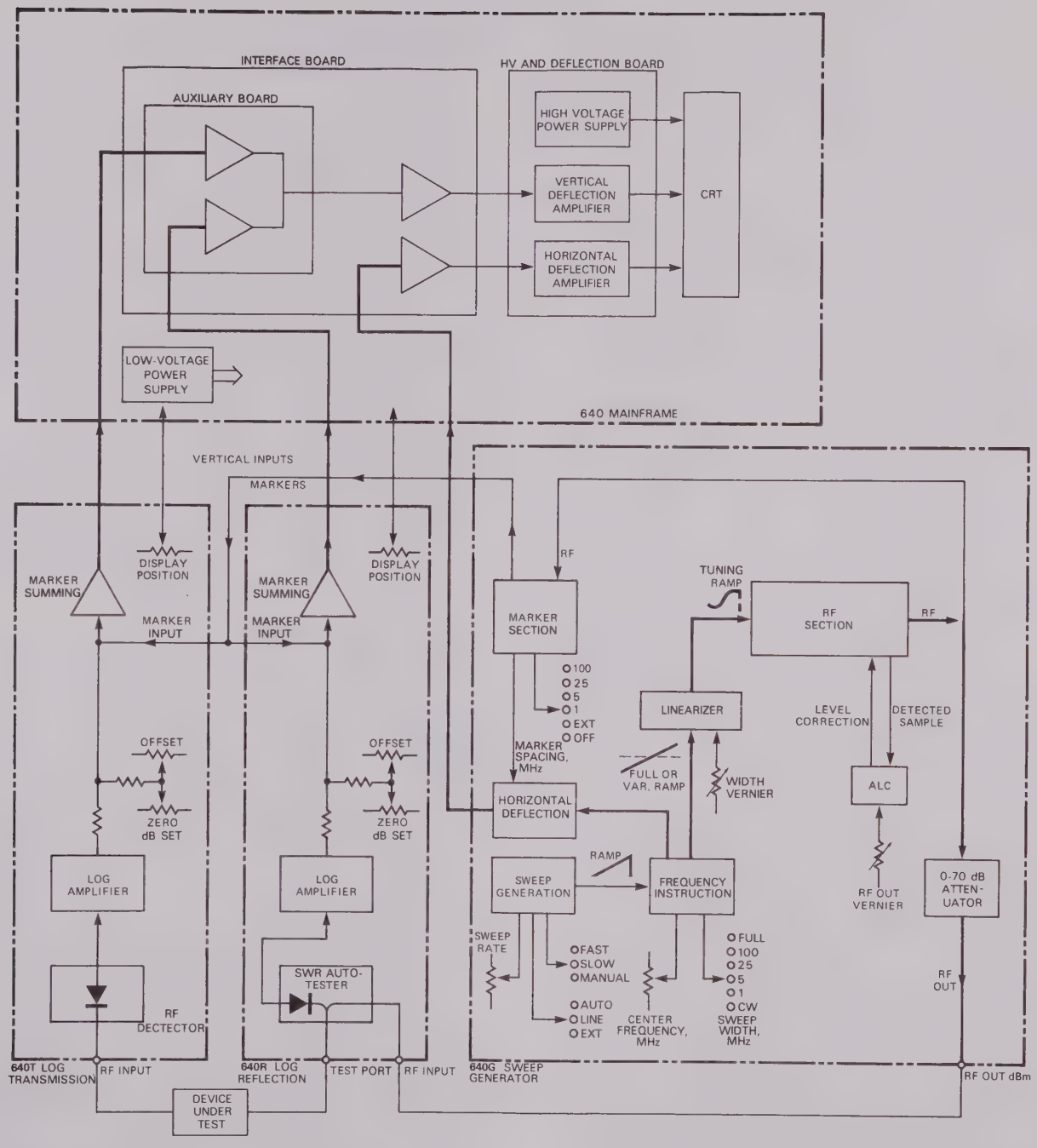


Figure 3-1. 640 RF Analyzer, Simplified Block Diagram

3-2.4 Log Transmission Plug-In

The log transmission plug-in measures the transmission loss/gain of the device under test. The operation of the log transmission plug-in is identical to the log reflection plug-in except the 640T Plug-In contains an RF detecto· instead of an SWR Autotester. As shown in Figure 3-1, the RF Detector detects the output signal from the Device Under Test and sends it to the Log Amplifier.

3-3 MODEL 640G SWEEP GENERATOR PLUG-IN

As shown in Figure 3-1, the Model 640G Sweep Generator Plug-In consists of the following sections:

1. Sweep Generation
2. Frequency Instruction
3. Horizontal Deflection
4. Linearizer
5. RF Section and ALC
6. Marker

3-3.1 Sweep Generation

This section of the plug-in consists of the Sweep Trigger circuit and the Sweep Generator circuit (Figure 3-2). The Sweep Trigger circuit produces three types of sweeps: AUTO, LINE, and EXT. In the AUTO mode, the Sweep Generator produces free-running sweeps. In the LINE mode, the Sweep Generator produces sweeps synchronized to the frequency of the line voltage. And, in the EXT mode, the Sweep Generator produces a ramp from an external trigger input or when the SINGLE SWEEP pushbutton is pressed. In addition, the Sweep Trigger circuit generates retrace blanking (negative) pulses during retrace time, which are sent via the Marker section, to disable the RF Section power supply and the log and linear amplifiers in the log and linear plug-ins. In all three modes, the Sweep Trigger circuit develops a 0 to +5V pulse to start the sweep ramp in the Sweep Generator circuit.

The Sweep Generator circuit produces three types of sweep ramps: FAST, SLOW, and MANUAL. In the FAST and SLOW modes, the sweep rate can be varied from 0.02 to 100 seconds by SWEEP RATE controls R3 and S5. In the MANUAL mode, R3 adjusts a dc voltage at the Sweep Generator circuit output that varies the CRT horizontal deflection beam and the 640G output frequency.

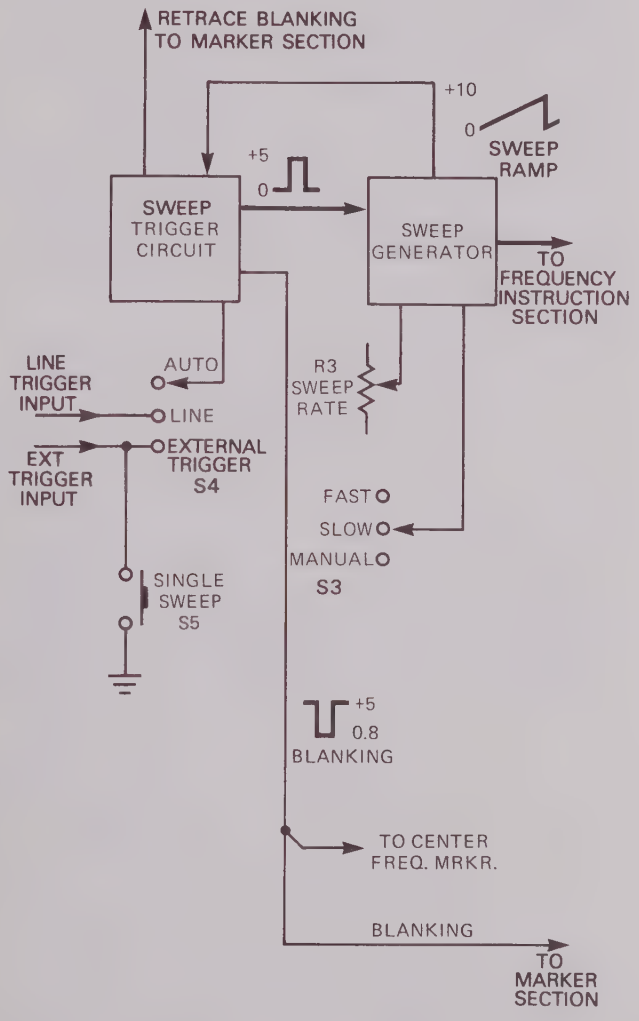


Figure 3-2. Model 640G, Sweep Generator Section

3-3.2 Frequency Instruction

The 0 to +10V ramp from the Sweep Generation section is applied to U14C (Figure 3-3). Regardless of the position of the SWEEP WIDTH switch, the 0 to +10V ramp from U14C is sent to U14A, the Horizontal Deflection section, and the Marker Section. The SWEEP WIDTH switch determines whether the Frequency Instruction output is either a full (0 to +10V) or variable ramp. When the switch is in the FULL position, the Enable Logic circuit closes switch contact pins 4 and 5 of Output Select Switch U9, to send the full ramp from U14A to the Linearizer section. On the other hand, when the switch is in the 100, 25, 5, or 1 MHz per division position, the Enable Logic circuitry closes pins 8 and 9 of U9 to send a variable ramp from U14A to the Linearizer and Marker sections via the WIDTH VERNIER potentiometer and U7B. The setting of the SWEEP RATE switch determines the amplitude of the variable ramp. When the SWEEP RATE switch is in the CW position, Enable Logic circuitry closes pins 8 and 9 of U9 to send a dc voltage to the Linearizer section via U7A and U7B. The CENTER FREQUENCY, MHz control determines the dc voltage level of the signal.

3-3.3 Horizontal Deflection

The full sweep ramp from U14C is applied to the noninverting input of U15C via U15B (Figure 3-4). U15B sums the full sweep ramp and the markers from the Marker section. Because U15B and U15C are in a cascade configuration, the markers can be either negative-going or positive-going.

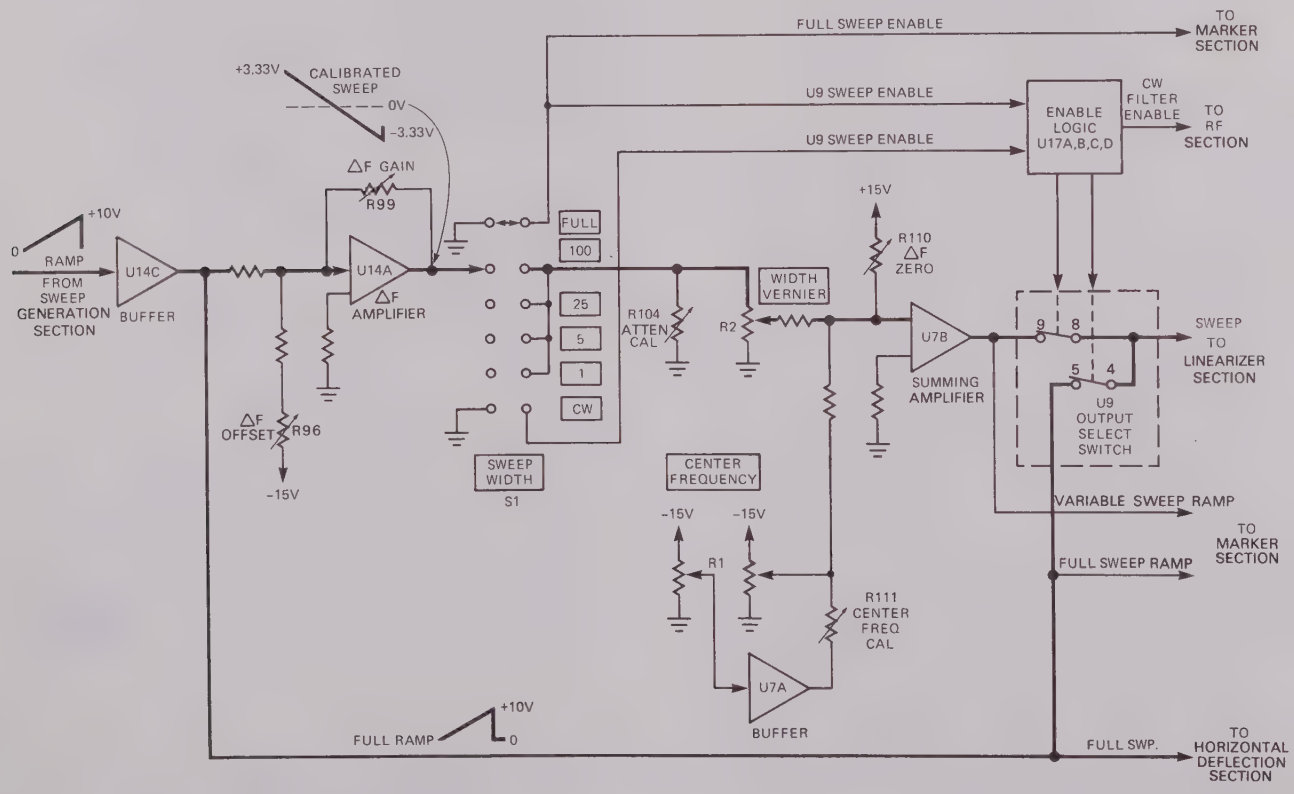


Figure 3-3. Frequency Instruction Section

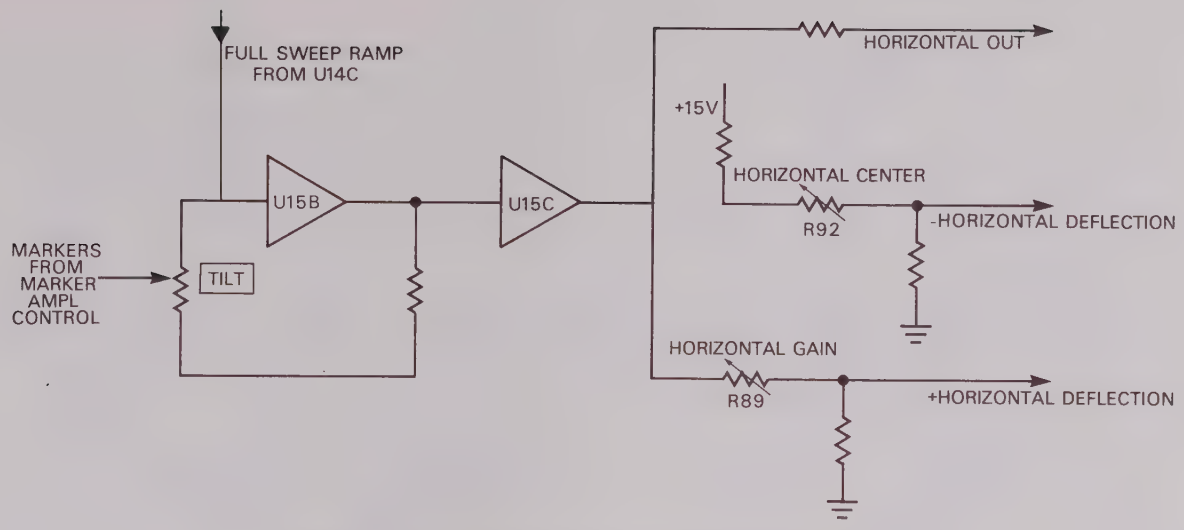


Figure 3-4. Horizontal Deflection Section

In other words, the vector summation of the positive-going and negative-going markers produces markers that tilt either left, right, or to any position between left and right, depending upon the setting of the TILT control. The full sweep ramp is then sent to the HORIZONTAL OUT connector on the rear panel and to the Positive Horizontal Deflection circuit. In the positive horizontal circuit, Horiz Gain R89 adjusts the amplitude of the ramp, while Horiz Center R92 adjusts the starting point of the ramp. Both horizontal deflection voltages are then applied to the Horizontal Deflection section in the 640 Mainframe.

3-3.4 Linearizer

The 0 to +10V ramp from the Frequency Instruction section is fed to FM Summing Amplifier U7D (Figure 3-5). In this discussion, it is assumed that the SWEEP WIDTH switch is in the FULL position. Because the output from the Frequency Instruction section is a 0 to +10V ramp, the U7D output is a 0 to -10V ramp that is routed to Shapers 1-4 (Q21-Q24) and to Ramp Shaper Amplifier U6. Each of the shaper circuits modifies a portion of the frequency instruction ramp to produce a shaped 0 to +10V ramp that is then amplified by Ramp Shaper Amplifier U6. This shaped tuning ramp is then applied to the Low and High Voltage-Tuned Oscillator (VTO) Tuning Drivers, U1 and U2, respectively. At the input of the Low and High VTO Tuning Drivers, potentiometers R157, R162, R167, and R172 provide independent adjustment of the low and high limits of the shaped tuning ramp. The shaped tuning ramps are then sent to the RF Section.

Equally important, the CW Filter circuit reduces noise and residual FM on the shaped tuning ramp. When either the MANUAL or CW mode is selected and FM/NORM switch S1 is in the NORM position, Relay Driver Q6 turns on. Q6 then closes relay K1 to add capacitance across the low and high VTO tuning lines to reduce noise and residual FM.

3-3.5 RF Section and ALC

The shaped tuning ramps from the Linearizer section are applied to the Lo Voltage-Tuned Oscillator (VTO) and the Hi VTO in the RF Section (Figure 3-6). The Lo VTO and Hi VTO outputs are mixed in a balanced mixer. The Low Pass Filter filters the mixer output before it is applied to the 30 dB Amp. The 30 dB Amp amplifies the signal and sends it to the RF OUT connector through the 0-70 dB Attenuator, while part of the RF output is detected by the RF Detector and sent to the Automatic Level Control (ALC) section that maintains the RF output at a constant level.

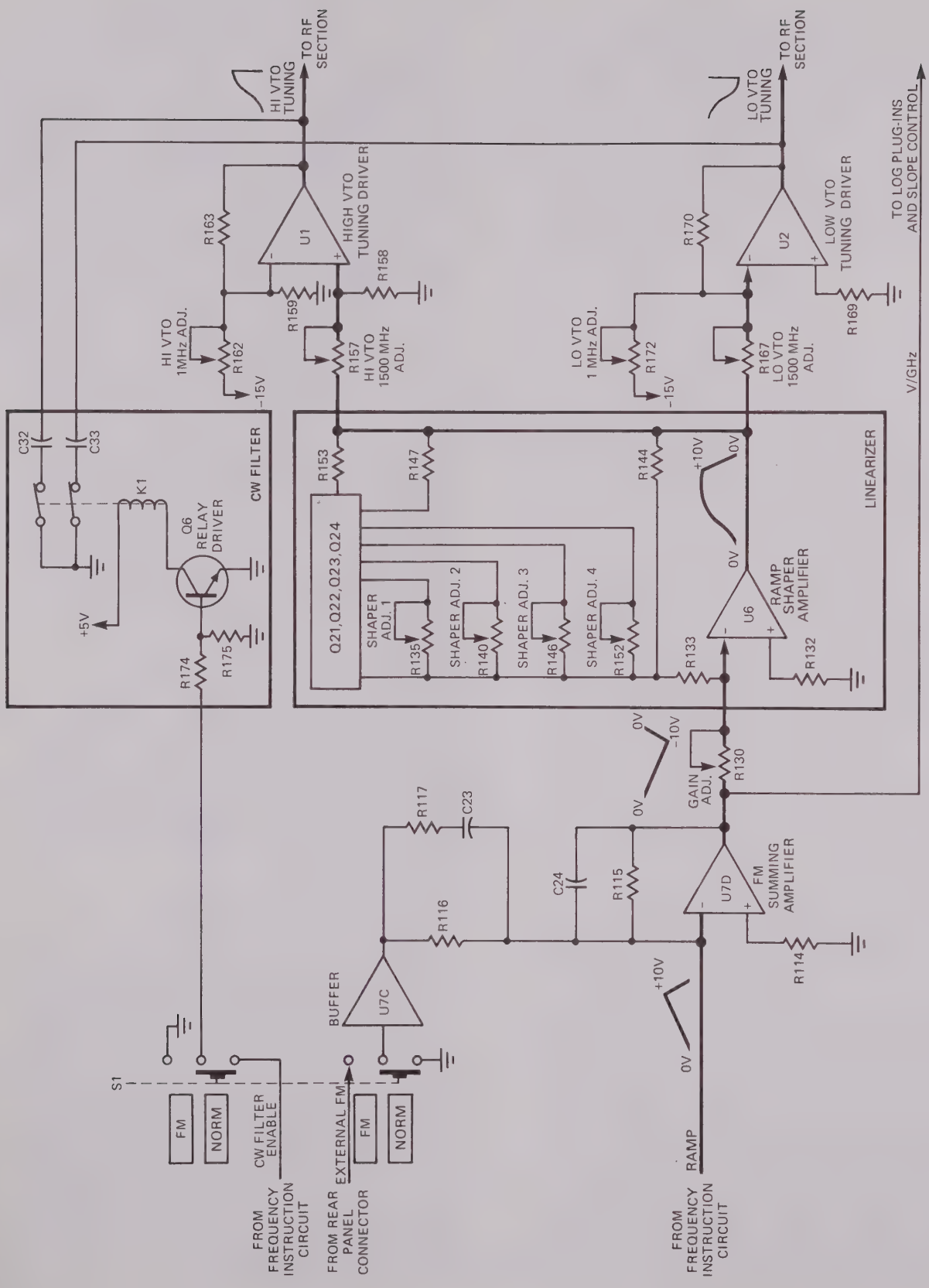


Figure 3-5. Linearizer Section

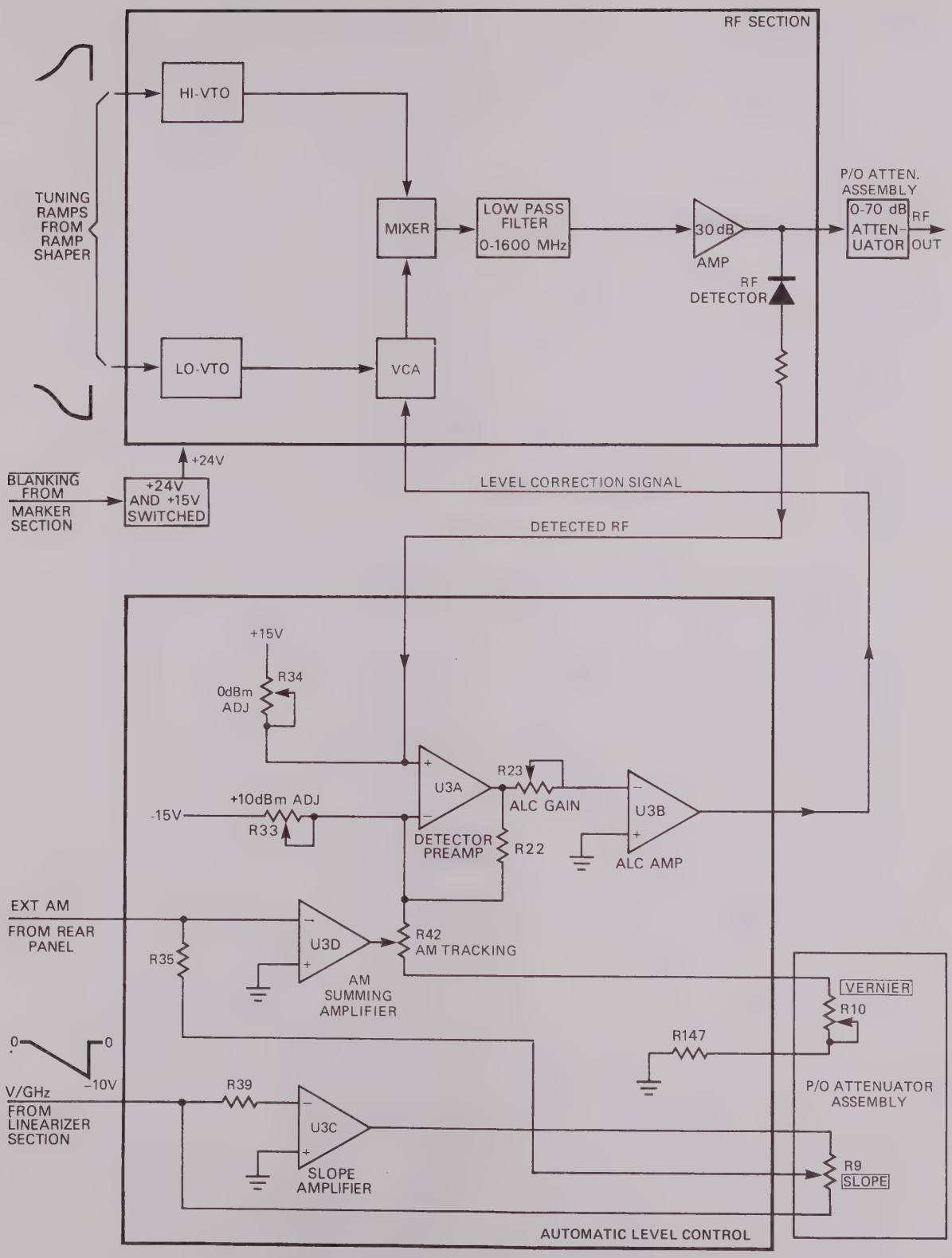


Figure 3-6. RF Section and ALC

The Vernier control establishes a reference level signal at the inverting input of Detector Preamp U5 (Figure 3-6). At the same time, the detected RF signal is applied to the noninverting input of U5. U5 compares the reference signal with the detected RF signal and amplifies the difference between the two signals. This difference signal is fed to ALC Amp U3B, which further amplifies the difference signal and sends it to the Voltage-Controlled Attenuator (VCA) in the RF Section as a level correction signal. The VCA either increases or decreases the RF output until it is equal to the reference level signal at the inverting input of Detector Preamp U5. In other words, the ALC circuit provides a feedback loop that maintains the RF output at a constant level. Note that AM Summing Amplifier U3B provides external RF power leveling control when an external AM signal is applied.

During retrace time, the Switched +24V and +15V power supplies turn off the RF Section. The blanking signals control +24V supply. The Sweep Generation circuit generates the blanking signal that is fed to the RF Section via the Marker section. The V/GHz signal from the Linearizer section provides slope control of the externally detected RF output. When the SWEEP WIDTH switch is in the FULL position, U7 applies a 0 to -10V ramp to Slope Amplifier U3A. The U3A output is delivered to SLOPE potentiometer R9 via AM Summing Amplifier U3B. The SLOPE control provides positive, negative, or no slope to the externally detected RF output.

3-3.6 Marker Section

The Marker section produces the variable center frequency marker and processes the harmonic markers. The inputs to the Marker Control circuit are the $\overline{\text{blanking}}$ (negative) signal from the Sweep Generation circuit and MARKER SPACING switch S2 (Figure 3-7). The Marker Control circuit produces enable signals that control the Marker Generator output, while during retrace the $\overline{\text{blanking}}$ (negative) signal inhibits the Marker Generator. In addition, MKR WIDTH potentiometer R4 controls the duration time of the markers. Harmonic markers are produced by heterodyning the Marker Generator output with the swept RF signal from the RF Section. The harmonic markers are then sent to the 640 Mainframe AMPL and TILT controls through Marker Summing Amplifier U15D. At the input of U15D, the variable frequency marker is summed with the harmonic markers. The inputs to the Center Frequency Marker circuit are the ΔF sweep, full sweep, full sweep enable, and $\overline{\text{blanking}}$ signals (Figure 3-7). The full sweep enable signal allows the center frequency marker to be displayed on the CRT when the SWEEP WIDTH switch is in the FULL position. Also, the $\overline{\text{blanking}}$ signal prevents the center frequency marker from being displayed during retrace.

The inputs to High Gain Amplifier U14D are the ΔF sweep and full sweep signals. The full sweep signal is a fixed 0 to +10V ramp from the Frequency Instruction section, while the setting of the CENTER FREQUENCY, MHz control determines the ΔF sweep amplitude. For example, when the CENTER FREQUENCY, MHz control is set to 750 MHz, the Center Frequency Marker circuit applies a dc signal to the inverting input of U14D, which produces a -13V output. When the input ramp reaches +5V, the U14D output will rise to 0V. As the input ramp climbs from +5 to +10V, the U14D output rises to +13V. The U14D output is routed to U15A through CR15 and CR16. When the U14D output is between -13 and 0V, CR5 conducts and applies the signal to the noninverting input of U15A; for that reason, the U15A output is 0V. On the other hand, when the U14D output rises from 0 to +13V, CR15 stops conducting and CR16 starts to conduct; consequently, the 0 to +13V portion of the U14D output is applied to the noninverting input of U15A. As a result, a center frequency marker is formed at the U15A output and applied to CR17 that clips the marker at -3V. Finally, the center frequency marker is sent to Marker Summing Amplifier U15D, where the center frequency marker and harmonic markers are combined.

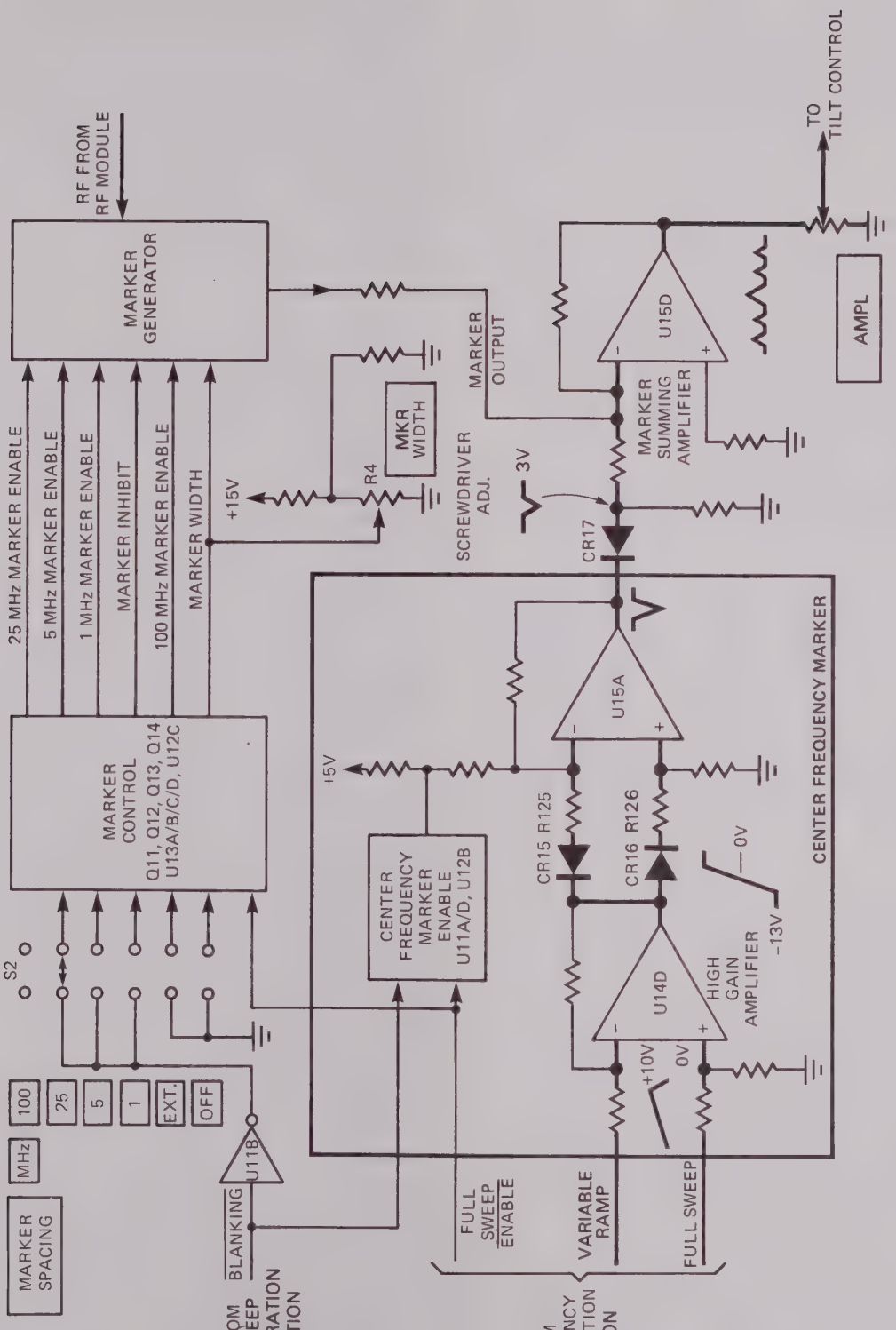


Figure 3-7. Marker Generation and Control, Simplified Diagram

3-4 LOG PLUG-INS

The 640 log plug-ins consist of the following sections: RF Components, Preamplifiers and Log Conversion, and Processor (Figure 3-8).

3-4.1 Internal and External RF Components

Each type of RF component is suited for a specific plug-in. For example, 640E and 640L Plug-Ins use a Model 7 Series external RF Detector or a Model 6 Series SWR Autotester. On the other hand, the 640R Plug-In has an internal SWR Autotester identical to the Model 6 Series external SWR Autotester. Likewise, the 640T Plug-In has an internal RF detector identical to the Model 7 Series RF Detector.

The RF detector consists of a detector and thermistor (Figure 3-9(A)). The detected RF is carried to the Preamplifier section by two wires. The thermistor, which corrects for detector temperature shifts, is connected to the Processor by two wires. The external RF detector contains a Cal resistor that provides for precise power level calibration of the detector to a reference source.

The SWR Autotester is similar to the RF detector except that the SWR Autotester contains a bridge (Figure 3-9(B)). When a device under test (DUT) is connected to the test port of the bridge and an RF signal is applied to the RF INPUT connector, a reflected voltage is produced at the output of the bridge. The amplitude of the reflected voltage depends upon the impedance match of the DUT. Then, the reflected voltage is detected and sent to the Preamplifier section.

3-4.2 Preamplifiers and Log Conversion

The Preamplifier section amplifies the detected RF, while the Log Conversion section converts the detected RF to a voltage proportional to the RF input level in dBm (Figure 3-8). Each preamplifier stage amplifies a distinct power range of the RF input signal. Each preamplifier output is sent to a separate input of the Log Conversion Module. A Zero potentiometer adjusts each preamplifier stage for a balanced output (Figure 3-10). Also, a 2.7V limiter restricts the output to no more than 2.7V. The Log Conversion Module converts the outputs from the Preamplifier stages to a log voltage that is applied to the Processor section.

3-4.3 Processor

The Processor routes the log signal to one of the Vertical Input channels of the 640 Mainframe (Figure 3-8). The log signal, thermistor current, and V/GHz signal are inputs to the Processor section. The thermistor current compensates for diode voltage output variations due to temperature shifts. The V/GHz signal is a 0 to +10V ramp, adjusted by Det Slope R31, that produces either a positive or a negative slope in the positive vertical output signal. In other words, the Det Slope adjustment compensates for the particular frequency-versus-power characteristics of the detector diode. The log signal is then sent to U13A, which acts as an integrator when SMOOTHING switch S2 is in the MIN or MAX position. In these two switch positions, U3A filters the noise on the log signal. Then, the log signal is processed by U12, which presents a calibrated log signal to Marker Summing Amplifier U15A. The OFFSET and ZERO dB SET controls as well as the OFFSET +/- and dBm/dB switches can be adjusted so that a low-level RF input signal is easily viewed on the CRT. On top of that, when ON switch S6 is in the ON position, the calibrated log signal is summed at Marker Summing Amplifier U15A with the center frequency and harmonic markers from Marker Summing Amplifier U15B. Finally, the vertical output signal, which consists of the log signal and the markers, is sent to a Vertical Input channel of the 640 Mainframe. During retrace, a $\overline{\text{blanking}}$ (negative) pulse from the sweep generator turns off Q12, which turns off the vertical output signal. Because the retrace line is not switched off during retrace, it acts as a reference line and is positioned by the DISPLAY POSITION control.

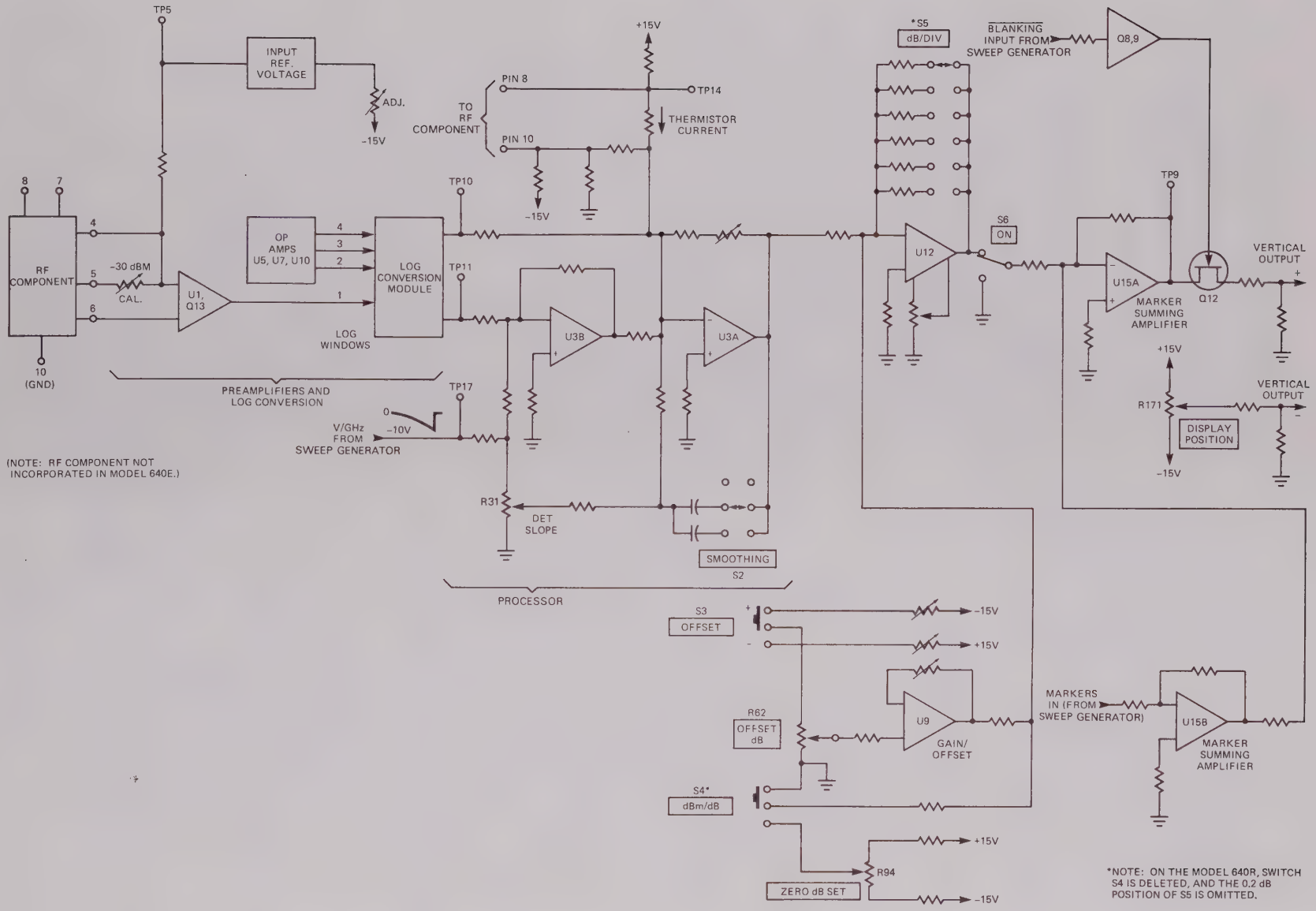
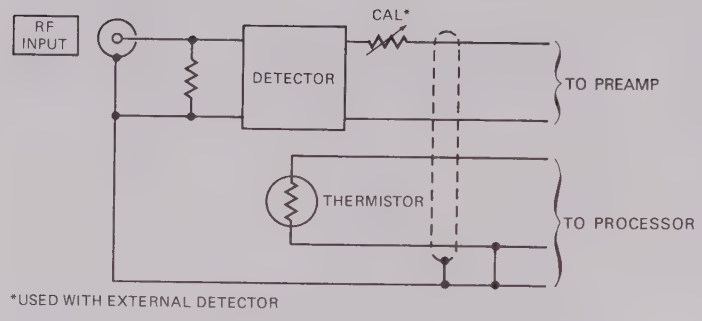
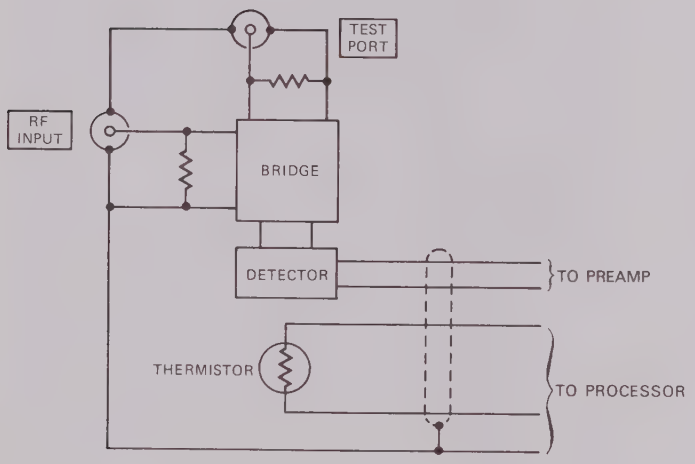


Figure 3-8. Log Plug-Ins, Simplified Block Diagram



(A) RF Detector



(B) SWR Autotester

Figure 3-9. Log Plug-In RF Components

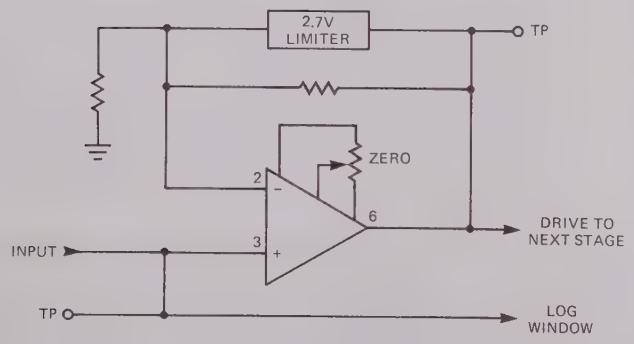


Figure 3-10. Log Preamplifier Stage

3-5 LINEAR AMPLIFIER PLUG-IN

The 640L Plug-In produces a linear output signal from a negative or positive detected signal from an external RF component.

3-5.1 Input Amplifier

A detected RF signal is applied to Input Amplifier U1 via the INPUT DC COUPLED connector (Figure 3-11). Depending upon the setting of INPUT switch S4, the detected signal is applied to either the noninverting or inverting input of Input Amplifier U1. Offset Buffer Amplifier U9 applies a dc voltage to the inverting input of U9. The OFFSET mV control varies the offset voltage so that low-level RF signals can be viewed on the CRT at high vertical sensitivities, such as 1mV per division. To eliminate the undesirable constant-level dc signal (such as a local oscillator portion of a detected signal) that may be present in the RF input signal, an input reference voltage is applied to the inverting input of U1 by switching Auto Null switch S3A to On.

3-5.2 Amplifiers and Sensitivity Select

The Input Amplifier sends the detected signal to Q13 via GAIN VERNIER control R93 that provides variable control of the Q13 output (Figure 3-11). Depending upon the setting of the mV/DIV switch, the detected signal will be sent either through U5 and U7, through U10 or directly to S5. For example, when either the 1000 or 250 mV/DIV position is selected, the detected signal is applied directly to U12. However, when any of the other positions is selected, the signal will by amplified by either U5, U7, or both. In other words, S5 selects the value of the input resistor, which determines the gain of U12. The calibrated signal from U12 is directed to Marker Summing Amplifier U15A.

3-5.3 Marker Summing

When ON switch S6 is in the ON position, the calibrated signal from U12 is applied to Marker Summing Amplifier U15A (Figure 3-11). Also, the center frequency and har-

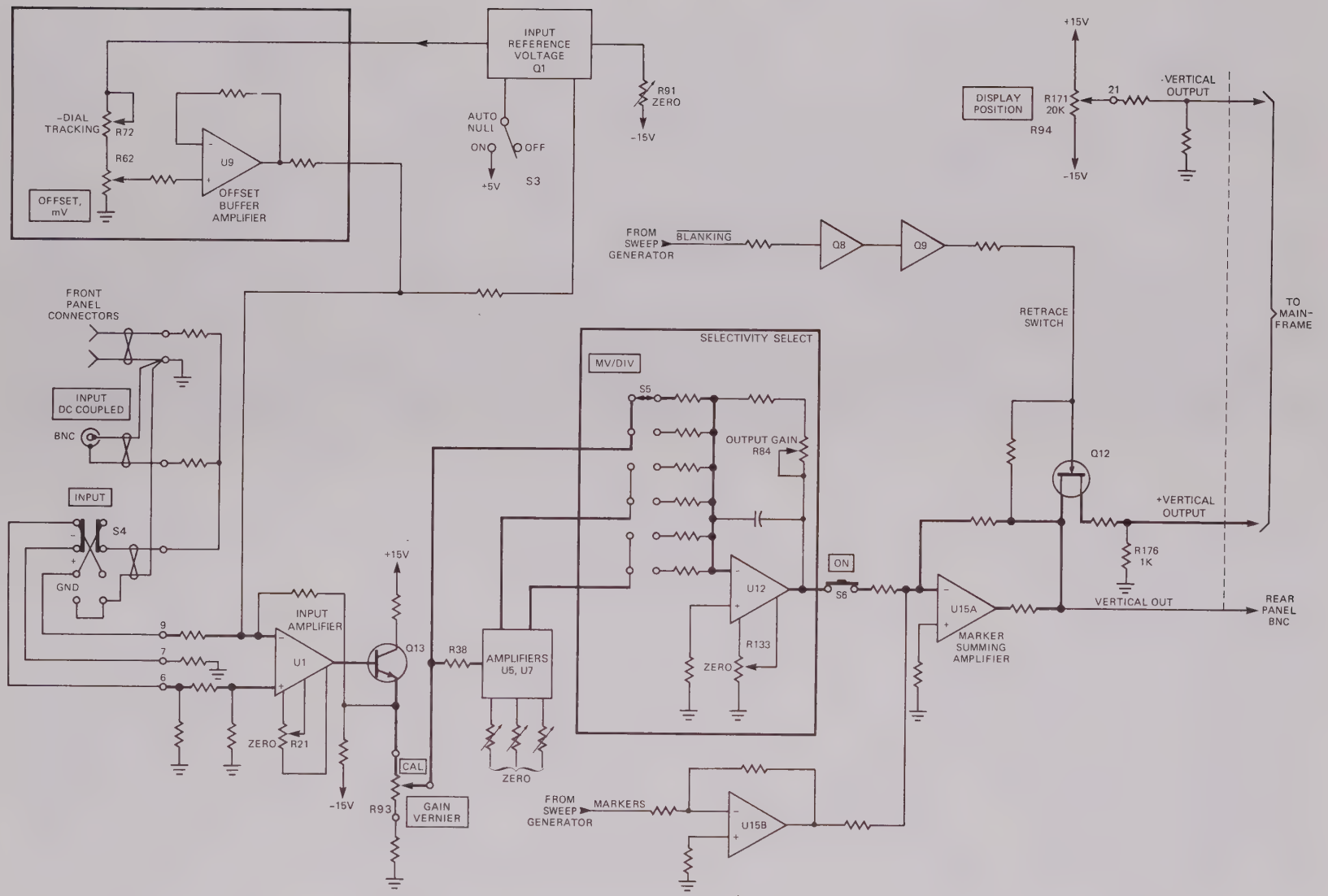


Figure 3-11. 640L Linear Amplifier, Simplified Block Diagram

monic markers from the 640G Plug-In are sent to the inverting terminal of U15A via U15B. On the other hand, when switch S6 is in the off position, only the center frequency and harmonic markers are sent to the Vertical Input of the 640 Mainframe. During retrace, the 640G blanking (negative) signal turns off the vertical output signal. Because the retrace line is not turned off, it acts as a reference line and is positioned by the DISPLAY POSITION control.

3-6 MODEL 640 MAINFRAME

The 640 Mainframe holds the plug-ins and contains the CRT display circuitry and main power supplies. As shown in Figure 3-12, the mainframe consists of the following four PC boards:

A1 - High Voltage and Deflection Board

This board contains the Horizontal and Vertical Deflection Amplifiers, Z-Axis Amplifier, and High-Voltage Power Supply for the CRT display. The signal inputs are the horizontal and vertical signals from the A3 board; the outputs are the vertical and horizontal deflection signals that are sent to the horizontal and vertical deflection plates of the CRT.

A2 - Auxiliary Board

This board contains Plug-In Switching circuits Q721 and Q722, which allow two log or linear vertical output signals to be simultaneously displayed on the single-beam CRT display.

A3 - Interface Board

This board contains interface connectors for the plug-ins, as well as the 200 kHz Clock and Countdown circuits for the Plug-In Switching circuit on the A2 board. It also contains the Vertical and Horizontal Amplifiers, which process their respective signals from the plug-ins. Also included are the Voltage Drop Assembly and the Pen Lift Assembly (optional).

A4 - Low-Voltage Power Supply

This board contains low-voltage rectifiers and regulators for the mainframe and plug-in circuits. The plug-ins themselves also contain regulators, which further regulate the dc voltages from the mainframe.

3-6.1 A3 Interface Board

The vertical output signals from the log or linear plug-ins are sent to the Vertical Amplifiers through the A2 Auxiliary Board (Figure 3-12). The marker, V/GHz, and blanking (negative) signals from the 640G Plug-In are directed to the log or linear plug-in via the A3 board. On top of that, the line trigger signal from the A4 board is routed to the 640G via the A3 board. The 50 kHz switching signal from the A2 board is generated by the A3 board. This signal is produced by dividing a 200 kHz clock signal from the Countdown circuit, U640. The 200 kHz Clock circuit, Q620 and Q626, develops a chop blanking signal that is sent to the Z-Axis Amplifier to eliminate the switching transients of the chopping circuits. The 640G horizontal signals are then processed by the Horizontal Amplifiers, which are identical to the Vertical Amplifiers. The horizontal amplifier output is fed to the Horizontal Deflection Amplifier on the A1 board.

The Voltage Drop Assembly provides three supply voltages for the 640G Plug-In: -18V, +18V, and +24V. These supplies are produced from the -30 and +30V supplies on the A4 board.

An optional Pen Lift Assembly can actuate an x-y recorder only when the SWEEP RATE switch is in the SLOW position. The Pen Lift relay contacts are accessed through the PEN LIFT connector on the rear panel of the mainframe.

3-6.2 A2 Auxiliary Board

The 50 kHz plug-in switching signal from the A3 board is sent to Plug-In Switching circuit

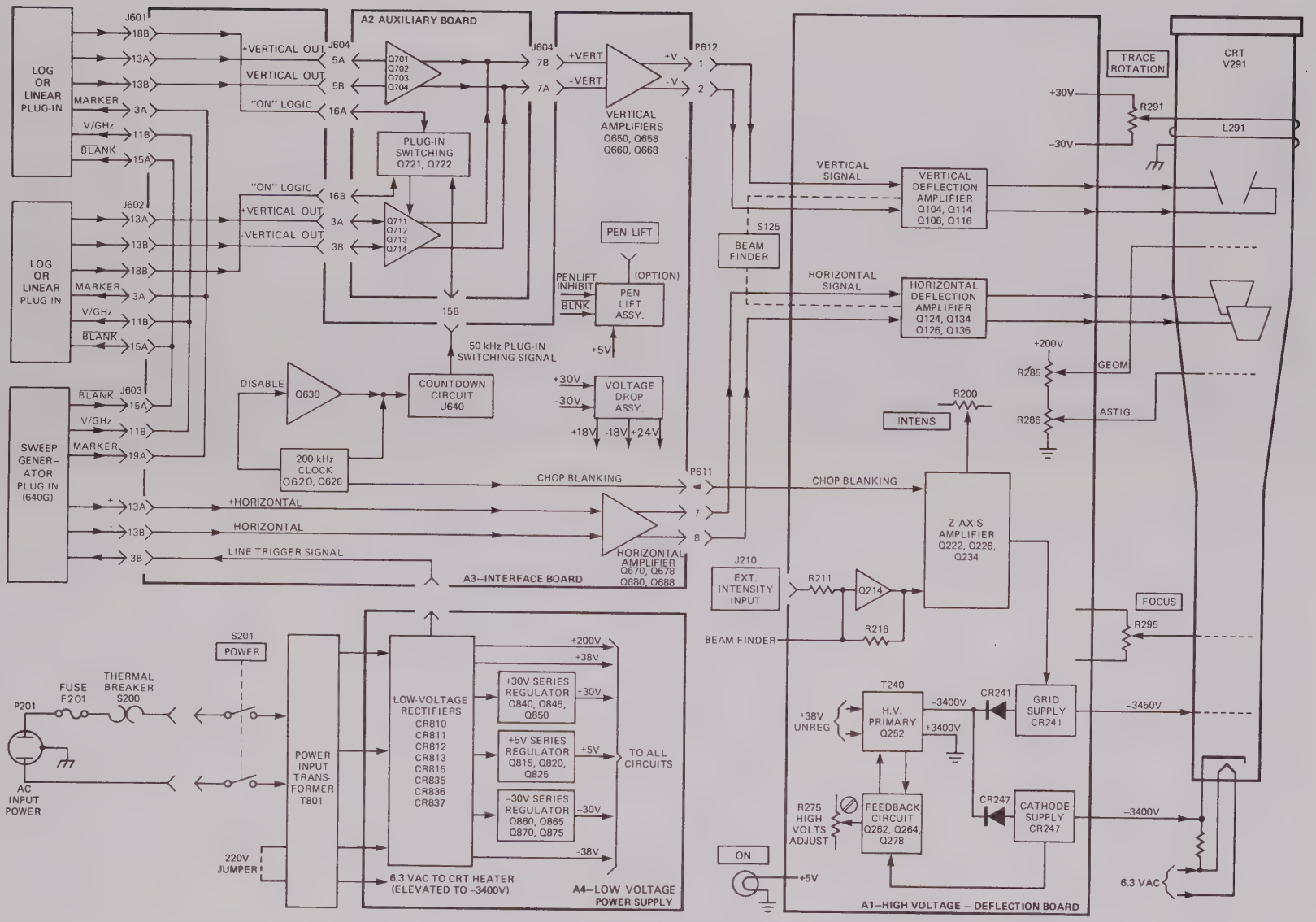


Figure 3-12. 640 Mainframe, Simplified Block Diagram

Q721 and Q722, which alternately switches between the two vertical channels (Figure 3-12). Alternate switching or "chopping" of the two log or linear signals allows them to be displayed simultaneously on the single-beam CRT display. The vertical output signals are fed to the Vertical Deflection Amplifier on the A1 board through the Vertical Amplifiers on the A3 board.

3-6.3 A1 High-Voltage and Deflection Board

The A1 board contains the Vertical and Horizontal Deflection Amplifiers, Z-Axis Amplifier, and High-Voltage Power Supply (Figure 3-12).

The Vertical Deflection Amplifier amplifies the vertical signals from the A3 board and sends them to the CRT vertical deflection plates. Similarly, the Horizontal Deflection Amplifier amplifies the horizontal signals from the A3 board and sends them to the CRT horizontal deflection plates. Furthermore, when BEAM FINDER switch S125 is pressed, the display trace appears in the center of the CRT regardless of the front panel control settings, because the emitter currents of the Horizontal and Vertical Deflection Amplifiers are decreased. The Z-Axis Amplifier controls the intensity of the display trace. The chop blanking, ext intensity input, and beam finder signals are inputs to the Z-Axis Amplifier. The output of the Z-Axis Amplifier is fed to the Grid Supply, which controls the intensity of the CRT beam.

The High-Voltage Power Supply provides two voltages for the CRT: -3400 and -3450V. The -3400V is developed by the H. V. Primary of T240 from pulses from Q252. Q252 is switched on by positive feedback from the primary of T240 and is turned off by the Feedback Circuit, which consists of Q262 and Q267. Also, Q278 samples voltage from another secondary winding of T240 to provide high-voltage regulation.

Note that a dc feedback path exists between the Cathode Supply and the Feedback circuit to improve high-voltage regulation. As a result, CR247 rectifies the -3400V and applies it to the cathode of the CRT through the Grid Supply. The -3450V on the CRT control grid is determined by either the setting of the INTENS control or by the external intensity input signal.

3-6.4 A4 Low-Voltage Power Supply Board

The A4 board supplies the low-voltage dc power for the mainframe and the plug-ins (Figure 3-12). The line voltage (nominally either 110 or 220V, 48 to 440 Hz) is applied to the primary windings of T801 through POWER switch S201, thermal circuit breaker S200, and fuse F201. Then, the secondary voltage is sent to the +30V, -30V, and +5V Series Regulators via the Low-Voltage Regulators. Also, note that the Low-Voltage Rectifiers have outputs: +200, +38, and -38V.

SECTION IV

MAINTENANCE

4-1 INTRODUCTION

This section provides recalibration procedures and a troubleshooting chart for the 640 RF Analyzer. These procedures consist of seven parts:

a. 640 Mainframe Tests and Adjustments

b. 640G Sweep Generator Plug-In Tests and Adjustments

c. 640E Log Plug-In Tests and Adjustments

d. 640L Linear Plug-In Tests and Adjustments

e. 640R Log Reflection Plug-In Tests and Adjustments

f. 640T Log Transmission Plug-In Tests and Adjustments

g. RF Components, Diode Replacement

Before performing the recalibration procedures, check that:

a. The 640 RF Analyzer, device under test, external RF components, and cables have the same characteristic impedance.

b. Good mechanical connections exist between cables, connectors, adapters, and terminations.

The recalibration procedures should be performed in sequence, because an adjustment of one circuit may affect the calibration of other circuits. Therefore, when trouble occurs during the recalibration procedure, the trouble must be corrected and the entire procedure repeated from the beginning. The troubleshooting chart, Table 4-1, can aid in isolating the defective section of the 640 RF Analyzer. (Table 4-1 is located at the end of this section.) Additional troubleshooting aids, such as voltage levels and waveforms, can be found in the schematics in Section VI. The test equipment listed in Table 4-2 can be used for all tests and adjustments in this section.

4-1.1 Test Equipment

The test equipment listed in Table 4-2 can be used for all tests and adjustments in this section.

4-1.2 Test Environment

The 640 RF Analyzer should be operated at an ambient temperature of 20° to 30°C for optimum performance. Also, allow the system to warm up at least one-half hour before beginning the recalibration procedures.

4-1.3 PC Assembly and Module Exchange

To reduce 640 system downtime, the following modules and pc assembly are available on an exchange basis from WILTRON for warranty and non-warranty repair.

640-ML-5145 RF Generator Section

640-ML-5225 RF Marker Section

640-ML-4625 Log PC Assembly

4-2 640 MAINFRAME TESTS AND ADJUSTMENTS

4-2.1 Mainframe Test Preparation

a. Remove the top right-hand cover and the bottom cover from the mainframe.

b. If the mainframe is a rack mounted unit, remove the top right-hand and bottom right-hand covers.

Table 4-2. Recommended Test Equipment

INSTRUMENT	REQUIRED CHARACTERISTICS	MANUFACTURER
RF DETECTOR	Input Impedance: 50Ω: 50Ω: 75Ω: 75Ω:	 WILTRON Series 7 RF Detector WILTRON Model 73N50 WILTRON Series 7 RF Detector WILTRON Model 73N75
EXTENDER CABLE	------	WILTRON Part No. 640-ML-5282
DIGITAL VOLTMETER	dc Voltage Range: to 200V	Fluke 8600A
HV PROBE	------	Fluke 80K-40
POWER SUPPLY	0 to 5 Volt Output	Hewlett-Packard Model 6216A
OSCILLOSCOPE	Bandwidth: 60 MHz Sensitivity: 1mV	Tektronix Model 5440/5A48/5A42
MODULATION METER	FM Measurement	Marconi Model TF2300
POWER METER POWER SENSOR POWER SENSOR	 50Ω: 75Ω:	Hewlett-Packard Model 435A Hewlett-Packard Model 8482A Hewlett-Packard Model 8483A
FUNCTION GENERATOR	1 kHz square wave	Krohn-Hite Model 5700
ATTENUATOR	0 to 60 dB in 10 dB steps	Hewlett-Packard Model 355D
10-PIN EXTENDER CABLE	------	WILTRON Part No. 640-B-7973
SMB CABLE	------	WILTRON Part No. 640-B-7972

c. Install a log or linear plug-in in the left-hand compartment.

d. Install a 640G Plug-In in the right-hand compartment.

4-2.2 DC Checks and Adjustments

a. On the mainframe, do the following:

1. Connect a DVM between each of the four test points and Ground, as shown in Figure 4-1.

2. Check that the voltages are within the tolerances listed in Table 4-3; if not, make the adjustments listed in the table.

Table 4-3. Mainframe DC Voltage Tests and Adjustments

V dc	Output Range	Adjustment	Ripple
+5	+4.89 to 5.11	--	<2mV
-30	29.89 to 30.11	R878	<2mV
+30	29.82 to 30.18	R858	<3mV
+200	175 to 247.5	--	<3V

3. Remove CRT base cover plate from the rear panel.

4. Connect a high-voltage probe to the -3400 volt test point shown in Figure 4-2. If the High Voltage is not within ±170V of -3400V, adjust High Volts Adj R275. (See Figure 4-3 for the location of R275.)

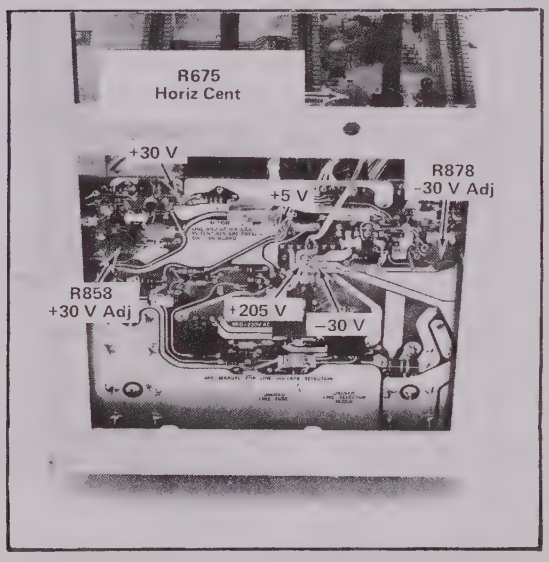


Figure 4-1. 640 Mainframe, Power Supply Test Points

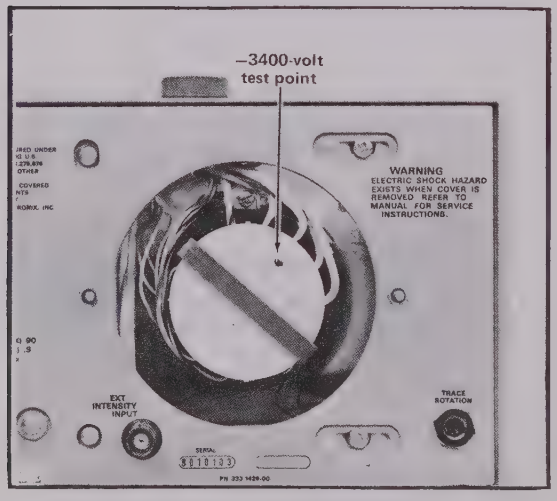


Figure 4-2. 640 Mainframe, -3400V Test Point

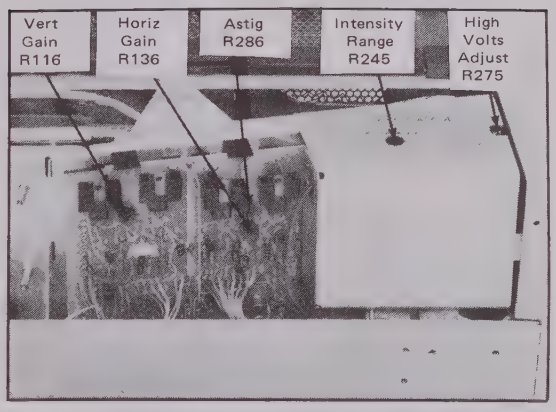


Figure 4-3. 640 Mainframe, HV and CRT Display Adjustments

4-2.3 Intensity Range, Astigmatism, and Geometry Adjustments

a. Set front panel control as follows:

640 Mainframe

TILT:	As required
AMPL:	As required
INTENS:	As required
FOCUS:	As required
POWER:	On

Log Plug-In

dB/DIV:	N/A
ZERO dB SET:	N/A
SMOOTHING:	OFF
DISPLAY POSITION:	Midrange
OFFSET:	N/A
+/-:	N/A
dBm/dB:	N/A
ON:	Pressed In

640G

MARKER SPACING:	OFF
SWEEP WIDTH:	FULL
WIDTH VERNIER:	Fully CW
SWEEP RATE:	FAST
Vernier:	Fully CW
RF OUT dBm:	0
Vernier:	Cursor at 3 o'clock position

CENTER FREQUENCY, MHz:	750
Vernier:	Cursor at 12 o'clock position
MKR WIDTH:	Fully CW
SLOPE:	Midrange

Linear Plug-In

mV/DIV:	1000
GAIN VERNIER:	Fully CW
INPUT:	- (negative)
DISPLAY POSITION:	As required
OFFSET, mV:	000
ON:	In

b. On the log or linear plug-in, adjust DISPLAY POSITION so trace is near the center of the graticule.

c. On the mainframe, do the following:

1. Adjust the INTENS control fully CCW.
2. Adjust Intensity Range R245 fully CCW (Figure 4-3).
3. While pressing the BEAM FINDER pushbutton, adjust R245 until the trace appears on the CRT.
4. Release BEAM FINDER pushbutton.
5. Adjust Astig R286 and FOCUS control for best definition of the trace on the CRT (Figure 4-3).
6. Adjust the TRACE ROTATION control on the rear panel of the mainframe so the trace is parallel to the horizontal graticule line.

d. On the 640G:

1. Set SWEEP RATE switch to MANUAL.
2. Turn SWEEP RATE control fully CCW.

e. On the mainframe:

1. Adjust INTENS control for normal brightness of the display dot on the CRT.
2. Adjust Geom R285 so the display dot is circular and in focus (Figure 4-3).

4-2.4 Vertical Gain Adjustments

a. On the rear panel of the mainframe, connect a DVM to the LEFT VERTICAL OUT connector. DVM should read 0 ± 25mV.

b. On the log or linear plug-in, adjust DISPLAY POSITION control so the display dot is on top of the center horizontal graticule line.

c. On the 640G, adjust SWEEP RATE control so display dot is precisely in the center of the CRT display.

d. If the 640E is used, connect a Model 7 Series RF Detector between the 640E RF INPUT connector and the 640G RF OUTPUT connector.

e. If the 640L is used, connect a Model 7 Series RF Detector between the 640L INPUT DC COUPLED connector and the 640G RF OUTPUT connector.

f. If either the 640R or 640T is used, connect a cable between the RF INPUT connector of the log plug-in and the 640G RF OUTPUT connector.

g. On either the linear or log plug-in, press in the ON button.

h. On the 640G, adjust the RF OUT dBm vernier until the DVM indicates 0 ±2mV.

i. On either the log or linear plug-in, adjust the OFFSET control until the counter indicates 40.00.

j. On the mainframe, adjust Vert Gain potentiometer R116 so the display trace is exactly on top of the top horizontal graticule line (Figure 4-3).

k. On the log plug-in, set +/- switch to - (negative). Check that the display dot is exactly on the bottom horizontal graticule line; if not, adjust R116 so the display dot is exactly on the bottom graticule line.

l. Repeat steps i, j, and k and adjust R116 for best accuracy in either position of the +/- switch.

m. On the log or linear plug-in, adjust OFFSET control so counter reads 00.0.

4-2.5 Horizontal Deflection Gain and Centering Adjustments

a. On the 640G, adjust SWEEP RATE control fully CCW.

b. On the mainframe, check on the CRT that the display dot extends beyond the far left vertical graticule line by the width of the display dot.

c. On the 640G, adjust SWEEP RATE control fully CW.

d. On the mainframe, check that the display dot extends beyond the far right vertical graticule line by the width of the display dot.

e. If the display dot does not extend beyond either the far left or right vertical graticule display line by the width of the display dot, do the following:

1. Push in POWER switch.
2. Remove 640G from mainframe.
3. Remove both side panels of 640G.
4. Reconnect 640G to mainframe through extender cable.
5. On 640G, connect DVM between pins 13A and 13B (Figure 4-4).
6. Adjust SWEEP RATE control until DVM reads 0 ± 1mV.
7. On the mainframe, adjust Horiz Cent R657 so the display dot is exactly in the center of the CRT display.
8. Adjust SWEEP RATE control clockwise until DVM indicates 250mV ± 1mV.
9. On the mainframe, adjust Horiz Gain R136 to place the dot outside the far right vertical graticule line by the width of the dot (Figure 4-1).

NOTE

If either the Horiz Cent or the Horiz Gain potentiometer is adjusted, the Frequency Instruction adjustments in paragraph 4-3.3 must be performed.

4-3 640G SWEEP GENERATOR PLUG-IN ADJUSTMENTS

4-3.1 Power Supply Adjustments

a. Connect 640G to the mainframe through an extender cable.

b. On 640G, perform the following steps:

NOTE

Use TP2 as reference ground for all dc measurements.

1. Referring to Figure 4-4, connect DVM to TP3.
2. Adjust -15V Adj R6 for -15V ±10mV.
3. Check that the voltages listed in Table 4-4 are within tolerance.

Table 4-4. 640G Power Supply Voltages

Test Point	Voltage	Tolerance
TP1	+15	±300mV
TP4	+24	±1.2V
TP5	+14.8	±200mV

4-3.2 Ramp Generator Checks

a. On 640G, do the following:

1. Set SWEEP RATE switch to FAST.
2. Set SWEEP RATE control fully CW.
3. Set TRIGGER switch to AUTO.
4. Connect an oscilloscope probe to TP9. Check on the scope that a -0.8V to +10V ±0.5V ramp exists. Rise time should be 22 ms ±4 ms. Retrace time should be 8 ms ±2 ms.
5. Adjust SWEEP RATE control fully CCW. Check on the scope that the ramp has a rise time of 2 seconds ±0.5 seconds.
6. Set SWEEP RATE switch to SLOW. Check on the scope that the ramp has a rise time of 100 seconds ±30 seconds.

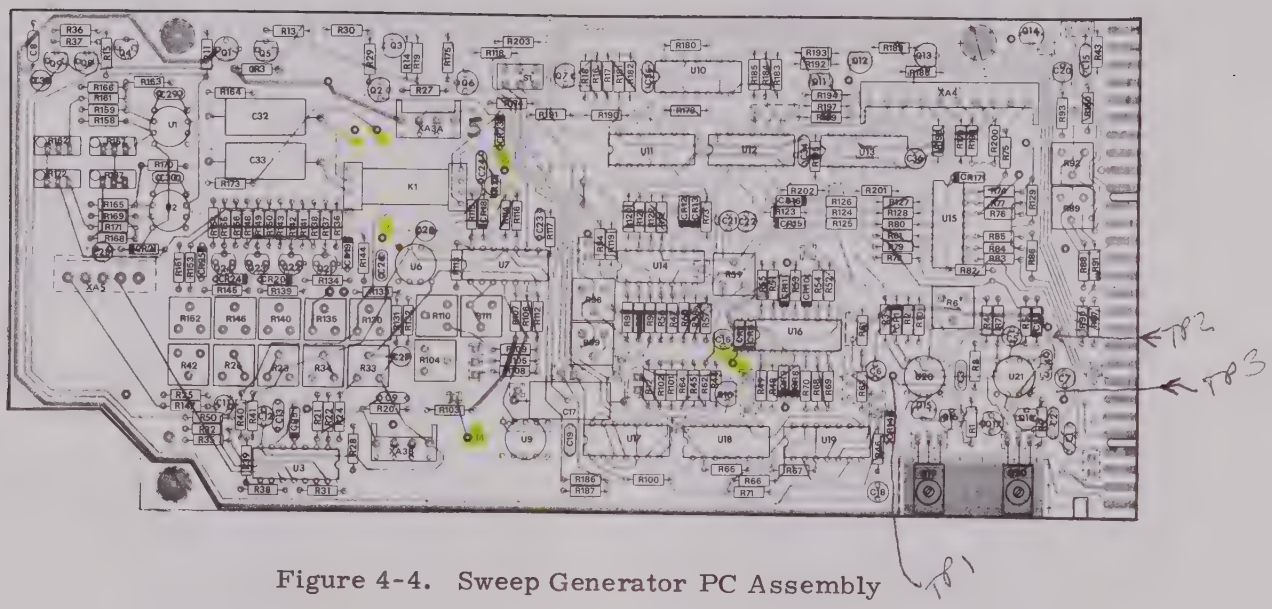


Figure 4-4. Sweep Generator PC Assembly

7. Adjust SWEEP RATE fully CW. Check on the scope that the ramp has a rise time of 2 seconds ±1.2 seconds.
8. Set TRIGGER switch to EXT.
9. Press SINGLE SWEEP pushbutton. Check on the scope that a single sweep occurs.
10. Set TRIGGER switch to LINE.
11. Set SWEEP RATE switch to FAST.
12. Check on the scope that when the SWEEP RATE control is adjusted CCW, the retrace time of the ramp varies.

4-3.3 Frequency Instruction Adjustments (Figure 4-4)

a. On 640G, do the following:

1. Set SWEEP RATE control fully CW.
2. Set SWEEP RATE switch to FAST.
3. Adjust Horiz Center R92 so display trace is one trace thickness beyond the far left vertical division line.
4. Adjust Horiz Gain R89 so display trace is one trace thickness beyond the far right vertical division line.
5. Repeat steps 3 and 4.
6. Set SWEEP RATE switch to MANUAL.
7. Adjust Manual Cal R59 so display dot is one dot thickness beyond the far right vertical division line.
8. Set CENTER FREQUENCY, MHz control to 0.
9. Set SWEEP WIDTH to 100.
10. Adjust SWEEP RATE control so display dot is exactly in the center of the CRT display.
11. Connect DVM to TP14.
12. Adjust ΔF Offset R96 for 0 ±1mV.
13. Connect DVM to TP15.
14. Set SWEEP WIDTH to FULL.
15. Adjust SWEEP RATE control fully CCW and record the voltage.
16. Adjust SWEEP RATE control fully CW and record the voltage.

17. Set SWEEP WIDTH to CW.
18. Set CENTER FREQUENCY, MHz control to exactly 0.
19. Set the CENTER FREQUENCY, MHz vernier so its cursor is pointing straight up.
20. Adjust Freq Instr Zero R110 until DVM reads the voltage recorded in step 15, ±1mV.
21. Set CENTER FREQUENCY, MHz control to 1500.
22. Check that the CENTER FREQUENCY, MHz cursor is pointing straight up.
23. Adjust Center Frequency Cal R111 until the DVM reads the voltage recorded in step 16, ±1mV.
24. Set CENTER FREQUENCY, MHz control to 0.
25. Set SWEEP WIDTH to 100.
26. Check that the SWEEP RATE control is fully CW.
27. Adjust ΔF Gain R99 until DVM reads 1/3 of the voltage in step 16 ±1mV.

4-3.4 Oscillator Voltage Adjustments (Figure 4-4)

a. On the 640G, do the following:

1. Set SWEEP WIDTH to FULL.
2. Set SWEEP RATE switch to MANUAL.
3. Check that SWEEP RATE control is fully CW.
4. Adjust Shaper Adj 1 thru 4, R135, R140, R146, and R152 fully CCW.
5. Connect DVM to TP17.
6. Adjust Gain Adj R130 until DVM indicates 10V ±10mV.
7. Locate the 1-1500 MHz RF Section and record from the label the four tuning voltages (Figure 4-5).

640G LEFT SIDE, FRONT CAVITY

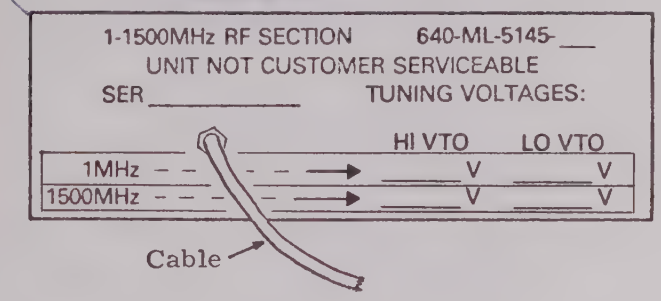


Figure 4-5. RF Section Label for Tuning Voltages

8. Connect DVM to TP19.
9. Turn SWEEP RATE control fully CCW.
10. Adjust Lo VTO 1 MHz Adj R172 until DVM indicates the 1 MHz Lo VTO tuning voltage on the label.
11. Connect DVM to TP18.
12. Adjust Hi VTO 1 MHz Adj R162 until DVM indicates the 1 MHz Hi VTO tuning voltage on the label.
13. Turn SWEEP RATE control fully CW.
14. Adjust Hi VTO 1500 MHz Adj R157 until DVM indicates the 1500 MHz Hi VTO tuning voltage.
15. Connect DVM to TP19.
16. Adjust Lo VTO 1500 MHz Adj R168 until DVM indicates the 1500 MHz Lo VTO tuning voltage.

4-3.5 RF Power Level Adjustments

a. Place a 640E or 640T in the left plug-in compartment.

b. On the log plug-in, do the following:

1. If the log plug-in is a 640E, connect a Model 7 Series RF Detector between the 640E RF INPUT connector and the 640G RF OUTPUT connector.

2. If the log plug-in is a 640T, connect a cable between the 640T RF INPUT connector and the 640G RF OUTPUT connector.
3. Push in the ON button.
4. Set dB/DIV to .2.
5. Set +/- switch to + (positive).
6. Adjust DISPLAY POSITION so retrace is near the center of the graticule.
7. Adjust OFFSET dB until counter indicates 10.5.

c. On the 640G, do the following:
1. Set RF OUT dBm to +10.
2. Turn RF OUT vernier fully CW.
3. Turn SWEEP RATE control fully CW.
4. Set SWEEP RATE switch to FAST.
5. Check that SWEEP WIDTH is in FULL position.
6. Adjust +10 dBm Adjust R33 (Figure 4-4) until the lowest point of the RF trace is on top of the retrace line.
7. Turn RF OUT vernier fully CCW.

d. On the log plug-in do the following:
1. Adjust OFFSET dB so counter reads 00.5.
2. Set +/- switch to - (minus).

e. On the 640G, adjust 0 dBm Adjust R34 until the lowest point of the RF trace is on top of the retrace line (Figure 4-4).

f. Repeat steps b, c, d, and e until no further improvement is noticed.

4-3.6 ALC Response Adjustments

a. On the log plug-in, do the following:
1. Adjust OFFSET dB so counter indicates 05.0.
2. Set +/- switch to - (minus).

b. On the 640G, do the following:
1. Adjust RF OUT vernier until the lowest point of the RF TRACE is on top of the retrace line.
2. Set SWEEP RATE switch to MANUAL.
3. Adjust SWEEP RATE control until the display dot is about one division from the far left vertical division line.

c. On the log plug-in, disconnect the cable from the RF INPUT connector.

d. On the function generator, do the following:
1. Adjust the Output for a 200mV peak-to-peak square wave with no dc offset.
2. Connect the Output to the EXT AM IN connector on rear panel of 640 Mainframe.

e. On the 640G, connect a Model 73 Series RF Detector to the RF OUT connector.

f. On the oscilloscope, do the following:
1. Connect the Vertical Input to the RF detector output.
2. Adjust front panel controls to obtain a 1 kHz square wave on the CRT display.

g. On the 640G, do the following:
1. Adjust ALC Gain R23 and ALC Response R26 (Figure 4-4) to obtain a square wave response with the following characteristics: 20μsec rise time, < 10% overshoot of the square wave amplitude, and no ringing.
2. At various settings of the RF OUT vernier, vary the SWEEP RATE control fully CCW and then fully CW while checking on the oscilloscope for the proper square-wave response, as described in step 1 above.

4-3.7 AM Tracking Adjustments

a. On the log plug-in, do the following:
1. Set +/- switch to + (positive).

2. Adjust OFFSET dB until the counter reads 09.5.
3. Set dB/DIV to .5.

b. On the 640G, do the following:
1. Set SWEEP RATE switch to FAST.
2. Midrange the SWEEP RATE control.
3. Set CENTER FREQUENCY, MHz control to 750.
4. Set SWEEP WIDTH to 1.
5. Place MARKER SPACING to OFF.
6. Rotate RF OUT vernier fully CW.
7. Disconnect Model 73 Series RF Detector from the RF OUT connector.

c. On the log plug-in, do the following:
1. If the plug-in is a 640T, connect a short cable between its RF INPUT connector and the 640G RF OUT connector.
2. If the log plug-in is a 640E, connect a Model 7 Series RF Detector between the RF INPUT connector and the 640G RF OUT connector.

d. Adjust the RF OUT vernier on the 640G and the Amplitude control on the function generator for a modulated RF trace between +9.0 and +10.0 dBm on the CRT display.

e. On the log plug-in, adjust OFFSET dB until counter reads 00.5.

f. On the 640G, do the following:
1. Adjust the RF OUT vernier to position the modulated RF trace symmetrically about +0.5 dBm.
2. Adjust AM Tracking R42 (Figure 4-4) until the modulated RF trace is 1 dB in amplitude.

g. Repeat steps d, e, and f until the modulation amplitudes are equal at +9.5 and +0.5 dBm.

h. On the 640 Mainframe, disconnect the cable from the EXT AM IN connector.

i. On the log plug-in, adjust OFFSET dB until the counter indicates 10.0.

j. On the 640G, do the following:
1. Adjust the RF POWER vernier until the lowest point of the RF trace is on top of the retrace line.
2. Adjust SLOPE control so the ends of the RF trace are at the same vertical height.

k. On the log plug-in, adjust OFFSET dB until the counter reads 00.0.

l. On the 640G, adjust the RF OUT vernier so the lowest point of the RF trace is on top of the retrace line. Check that the slope of the RF trace is less than .5 dB.

m. If the slope is greater than .5 dB, adjust AM Tracking R42 (Figure 4-4) and then repeat steps b through f in paragraph 4-3.5.

4-3.8 Linearizer Adjustments (Figure 4-4)

a. On the log plug-in, do the following:
1. Set +/- switch to + (positive).
2. Adjust OFFSET dB control until counter indicates 10.0.
3. Set dB/DIV to 10.

b. On the 640G, do the following:
1. Turn RF OUT vernier fully CW.
2. Set SWEEP WIDTH to FULL.
3. Set MARKER SPACING to 100.
4. Set CENTER FREQUENCY, MHz to 0.
5. Check that the cursor of the CENTER FREQUENCY, MHz control is straight up.
6. If the zero beat on the CRT is not precisely on top of the far left vertical division line, adjust Lo VTO 1 MHz Adj R172.
7. If the 1500 MHz marker is not precisely on top of the far right vertical division line, adjust Lo VTO 1500 MHz Adj R168.

8. Set SWEEP WIDTH to 100.
9. Turn CENTER FREQUENCY, MHz control until the zero beat is exactly on the far left vertical division line.
10. If necessary, use the CENTER FREQUENCY, MHz Vernier to place the zero beat exactly on the far left vertical division line.
11. Adjust Gain Adj R130 to place the 300 MHz marker exactly on the ~~first~~ 3rd major division line from the left side.
12. Adjust Shaper Adj 1 R135 to place the 500 MHz marker exactly on the ~~third~~ major vertical division line from the left side.
13. Adjust Shaper Adj 2 R140 to place the 900 MHz marker exactly on the ~~sev-~~ enth major vertical line from the left side.
14. Turn CENTER FREQUENCY, MHz control to place the 1000 MHz marker exactly in the center of the graticule.
15. Adjust Shaper Adj 3 R146 to place the 1000 MHz marker exactly on the ~~far-~~ right vertical line.
16. Adjust Shaper Adj 4 R152 to place the 1500 MHz marker exactly on the far-right line.
17. Turn CENTER FREQUENCY, MHz control to place the 500 MHz marker exactly in the center of the graticule.
18. If a 100 MHz marker is more than one minor division from a major division line, repeat steps 11 through 16.
19. Turn CENTER FREQUENCY, MHz control to place the 1000 MHz marker exactly in the center of the graticule.
20. If a 100 MHz marker is more than one minor division from a major division line, repeat step 16.
21. Set SWEEP WIDTH to 1.
22. Set MARKER SPACING to 1.
23. Adjust the CENTER FREQUENCY, MHz vernier to center a 1 MHz marker on top of a major division line.
24. Adjust Atten Cal R104 until the spacing between the centers of adjacent 1 MHz markers is exactly one major division.

4-3.9 Final Frequency Instruction Adjustments (Figure 4-4)

a. On the 640G, do the following:
   1. Set SWEEP WIDTH to 5.
   2. Set MARKER SPACING to 100.
   3. Set CENTER FREQUENCY, MHz control to 0.
   4. Check that the cursor of the CENTER FREQUENCY, MHz control is straight up.
   5. Adjust Freq Instr Zero R110 to place the zero beat exactly in the center of the graticule.
   6. Set CENTER FREQUENCY, MHz control to 1500.
   7. Adjust Center Freq Cal R111 to place the 1500 MHz marker exactly in the center of the graticule.

4-3.10 Harmonics, Spurious and Residual FM Tests

a. On the 640G, do the following:
   1. Set SWEEP WIDTH to CW.
   2. Set MARKER SPACING to OFF.
   3. Set TRIGGER to EXT.
   4. Set CENTER FREQUENCY, MHz to 750.
   5. Check that FM/NORM switch on PC board is in NORM position.
   6. Set RF OUT dBm to +10.
   7. Connect power meter to RF OUT connector.
   8. Adjust RF OUT dBm until power meter indicates +10 dBm.
   9. Disconnect power meter from RF OUT connector.

10. Connect Input of spectrum analyzer to RF OUT connector.
11. Set CENTER FREQUENCY, MHz to 0.
12. Adjust CENTER FREQUENCY, MHz vernier and track on spectrum analyzer the 640G output from 1 to 5 MHz. Check that harmonics are at least 25 dB below the carrier and spurious are at least 45 dB below the carrier.
13. Rotate CENTER FREQUENCY, MHz control from 0 to 1500 on the dial and track on the spectrum analyzer. Check that harmonics are at least 30 dB below the carrier and spurious are at least 45 dB below the carrier.
14. Set CENTER FREQUENCY, MHz to 100.
15. Disconnect spectrum analyzer from RF OUT connector.

NOTE

Do not measure residual FM with a spectrum analyzer, because it does not have the 30 Hz to 28 kHz bandwidth to measure residual FM.

16. Connect Input of modulation meter to RF OUT connector. Check that residual FM is less than 7 kHz peak.
17. Set CENTER FREQUENCY, MHz to 1200. Check that residual FM is less than 7 kHz peak.
18. If harmonics, spurious, or residual FM are out-of-tolerance, perform all steps in paragraph 4-3.11.

4-3.11 RF Section Troubleshooting and Replacement

a. On the 640G, do the following:
   1. Set SWEEP WIDTH to FULL.
   2. Set TRIGGER to AUTO.
   3. Set SWEEP RATE switch to FAST.
   4. Rotate SWEEP RATE control fully CW.
   5. Set RF OUT dBm to +10.
   6. Adjust RF OUT vernier fully CW.
   7. Check that TP4 is +24V ±1.2V (Figure 4-4).
   8. Check that TP5 is +14.2V ±200mV (Figure 4-4).
   9. Check for proper waveforms at TP18 and TP19 (Figures 4-4 and 6-8).

b. If log plug-in is 640T, connect cable between the 640T RF INPUT connector and the 640G RF OUT connector.

c. If log plug-in is 640E, connect Model 7 Series RF Detector between the 640E RF INPUT connector and the 640G RF OUT connector.

d. On the log plug-in, do the following:
   1. Set dB/DIV to 1.
   2. Adjust OFFSET dB so counter indicates 10.5.
   3. Set +/- to + (positive).
   4. Set dBm/dB switch to dBm.
   5. Adjust DISPLAY POSITION control to place reference line near the center of the CRT.
   6. Press in the ON button.

e. On the 640G, do the following:
   1. Short TP7 to TP2 (Figure 4-4).
   2. Check on the CRT that the RF power increases to at least +10.5 dBm.
   3. If power does not increase to at least +10.5 dBm, check TP6, TP7 and TP8 (Figures 4-4 and 6-10).
   4. If neither TP6, TP7 nor TP8 reveals the trouble, check the 0-70 dB Attenuator, RF cables and connectors.
   5. If the above checks do not reveal the trouble, replace the RF Section.

f. To replace the RF Section, do the following:
   1. Push in the POWER switch.

2. Remove 640G from mainframe.
3. Remove side covers from 640G.
4. Remove the eight screws from the top and bottom extrusions.
5. Disconnect RF Section output cable from 0-70 dB Attenuator.
6. Lift RF Marker subassembly from the 640G PC board.
7. Remove the two screws from the overlapping bottom plate on the Marker Section side of the subassembly.
8. Unplug the RF Section from the Marker Section.
9. Plug the replacement RF Section into the Marker Section.
10. Insert and tighten the two screws in the overlapping bottom plate on the Marker Section side of the subassembly.
11. Plug the subassembly into the 640G PC board.
12. Install and secure the eight screws in the top and bottom extrusions.
13. Replace the side covers.
14. Connect 640G to the mainframe through an extender cable.
15. Pull out the POWER switch.
16. Perform all steps in paragraphs 4-3.3 through 4-3.10.

4-3.12 Marker Section Troubleshooting and Replacement

NOTE

In the following tests, insert two log plug-ins in the 640 Mainframe.

a. On the 640G, do the following:
   1. Set SWEEP WIDTH to FULL.
   2. Rotate RF OUT Vernier fully CW.
   3. Set RF OUT to +10.
   4. Set SWEEP RATE switch to FAST.
   5. Set SWEEP RATE control fully CW.
   6. Set MARKER SPACING to 100.

b. If log plug-in is a 640T, connect cable between its RF INPUT connector and the 640G RF OUT connector.

c. If log plug-in is a 640E, connect Model 7 Series RF Detector between its RF INPUT connector and the 640G RF OUT connector.

d. On the log plug-in, do the following:
   1. Set dB/DIV to 10.
   2. Set dBm/dB switch to dBm.
   3. Set +/- switch to + (positive).
   4. Push in the ON button.
   5. Adjust DISPLAY POSITION to place retrace near the center of the CRT.
   6. Adjust OFFSET dB until counter reads 10.5.

e. Check on CRT display for fifteen 100 Hz markers.

f. If fifteen 100 MHz markers are not displayed on the CRT, do the following:
   1. Connect 640G to mainframe through an extender cable.
   2. Connect a scope probe to each XA4 connector pin and refer to Table 4-5 for the proper voltage levels (refer to Figure 4-4 for the location and pin numbers of the XA4 connector).
   3. Set MARKER SPACING switch to each position listed in Table 4-5 and check for the proper voltage levels.

g. If the Marker Control section does not reveal the trouble, do the following:
   1. Push in POWER switch.
   2. Remove 640G side covers.
   3. Remove the eight screws from the top and bottom extrusions of the 640G.
   4. Disconnect RF Section output cable from the 0-70 dB Attenuator.

Table 4-5. Voltages at Marker Section XA4 Connector on the 640G PC Assembly

MARKER SPACING	CONNECTOR PIN NO. (1, 2, 3)									
	1	2	3	4	5	6	7	8	9	10
100	-15V	-15V	+5V	(0)	(1-F) (0-R)	(0)	(0)	(0)	(0)	Note 4
25	-15V	-15V	+5V	(1-F) (0-R)	(1-F) (0-R)	(0)	(0)	(0)	(0)	Note 4
5	-15V	-15V	+5V	(1-F) (0-R)	(1-F) (0-R)	(1-F) (0-R)	(0)	(0)	(0)	Note 4
1	-15V	-15V	+5V	(1-F) (0-R)	(1-F) (0-R)	(1-F) (0-R)	(0)	(1-F) (0-R)	(0)	Note 4
EXT	-15V	0V	+5V	(0)	(1-F) (0-R)	(0)	(0)	(0)	(0)	Note 4
OFF	-15V	-15V	+5V	(0)	(0)	(0)	(0)	(0)	(0)	Note 4

NOTES

1. (0) = logic zero (≈0V) during sweep and retrace.
2. (1-F) = logic one (≈2.5 to 5.5 V) during sweep.
3. (0-R) = logic zero (≈0V) during retrace.
4. Set MARKER SPACING switch to each setting listed below and check the amplitude of the markers.

MARKER SPACING	AMPLITUDE (V)
100	≈-0.8
25	≈-1.9
5	≈-2.8
1	≈-3.7

5. Unplug RF Marker subassembly from the 640G PC board.
6. Remove the two screws from the overlapping bottom plate on the Marker Section side of the subassembly.
7. Unplug the RF Section from the Marker Section.
8. Connect the RF Section output cable to the 0-70 dB Attenuator.
9. Connect an SMB cable (WILTRON Part No. 640-B-7972) between the RF Section MKR OUT connector and the Marker Section RF INPUT connector.
10. Connect an extender cable (WILTRON Part No. 640-B-7973) between the XA4 connector on the 640G PC board and the XA4 connector on the Marker Section.
11. Pull out the POWER switch.

h. If the fifteen 100 MHz markers appear on the CRT, check that the RF Section MKR OUT connector pin is properly mated with the Marker RF IN connector when the subassembly is plugged together.

i. If the 15 100 MHz markers do not appear on the CRT, do the following:
   1. Set CENTER FREQUENCY, MHz to 750.
   2. Set SWEEP WIDTH to CW.
   3. Set TRIGGER to EXT.
   4. Connect power meter to RF Section MKR OUT connector.

j. If power meter does not indicate -14 dBm ±1 dB, replace the RF Section.

k. If power meter does indicate -14 dBm ±1 dB, do the following:
   1. Connect a cable between the HORIZONTAL OUT connector on the rear panel of the 640 Mainframe to the External Horizontal Input of the scope. Set scope for External Horizontal mode.
   2. Push in POWER switch.
   3. Set SWEEP WIDTH to 100.
   4. Set TRIGGER to AUTO.
   5. Set MARKER SPACING to 100.
   6. Remove top cover of Marker Section.
   7. On Processor PC Board 640-MS-5121, connect scope probe to TP4 (Figure 4-6).
   8. Pull out POWER switch.
   9. On the scope, check for a 17V peak-to-peak ±2V waveform.

l. If the 100 MHz markers are present at TP4, do the following:
   1. Set MARKER SPACING to 1.
   2. Set SWEEP WIDTH to 1.
   3. Connect scope probe to pins 8, 10 and 12 of the XA4A2 connector (Figure 4-6).

m. If 100mV peak-to-peak waveforms are present at pins 8, 10 and 12 of the XA4A2 connector, check for 17V peak-to-peak ±2V waveforms at TP1, TP2 and TP3.

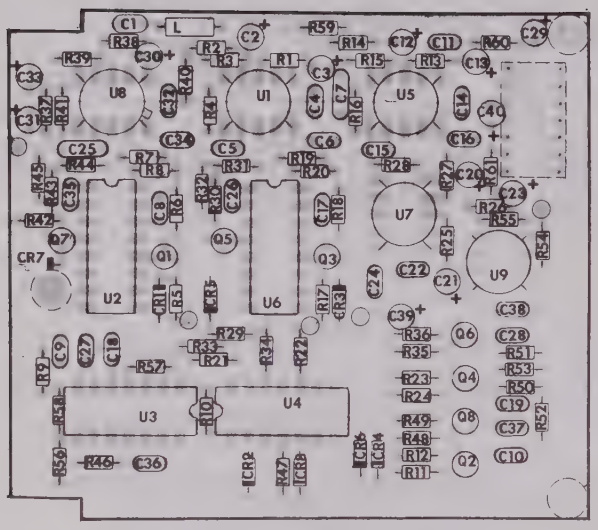


Figure 4-6. Processor PC Board, Marker Section

n. If above waveforms are present, check TP5.

o. If waveforms at pins 8, 10, 12 and 14 are not present, do the following:

1. Push in POWER switch.
2. Remove bottom cover of Marker Section.
3. Place a Marker Section fastening screw in Hole A to hold the RF and Processor PC boards together (Figure 4-7).

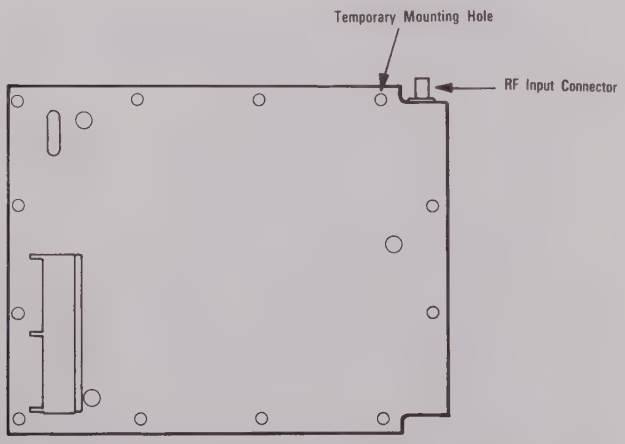


Figure 4-7. Marker Section, Top View

NOTE

Weak markers may result if the RF IN connector is not properly grounded by the fastening screw in Hole A.

4. Set Scan Width of spectrum analyzer to 10 MHz per division and set Frequency control to 100 MHz.
5. Connect Input of spectrum analyzer to TP1 on RF PC board (Figure 4-8).
6. Pull out POWER switch.

p. If 100 MHz marker is absent at TP1, do the following:

1. Connect Input of spectrum analyzer to collector of Q1 (Figure 4-8).
2. If 100 MHz signal is not present, adjust C3 (Figure 4-8).
3. If the above tests do not reveal the trouble, check stages Q6 through Q10, U1 and their components (Figure 4-8).

q. If either the 25, 5 or 1 MHz marker is absent from the CRT display, check for the 100 MHz waveform at pin 1 of U2 (Figure 4-8).

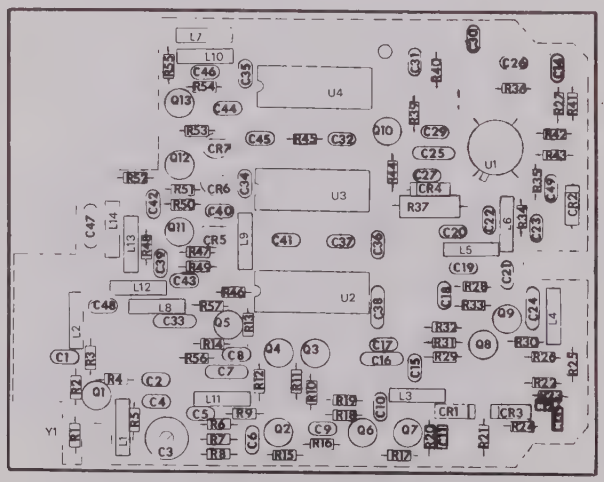


Figure 4-8. RF PC Board, Marker Section

r. If the 100 MHz waveform is absent at pin 1 of U2, check Q3, Q4, Q5 and their components (Figure 4-8).

s. If the 100 MHz waveform at pin 1 of U2 is present but the 25 MHz waveforms at pins 8 and 9 are absent, do the following:

1. Locate R57 (Figure 4-8). R57 is a factory-select resistor that may or may not be used.
2. If R57 is used, unsolder one end of the resistor and check with a spectrum analyzer for 25 MHz waveforms at pins 8 and 9 of U2.
3. If the previous step does not solve the trouble, change the value of R57 to 2kΩ, while checking for 25 MHz waveforms at pins 8 and 9 of U2. If 2kΩ does not solve the trouble, change the value to 7.5kΩ.
4. If the previous step does not solve the problem, replace U2. However, do not replace U2 with a National 74S113 chip.

NOTE

When U2 is replaced, it may be necessary to change R57 to either open circuit, 7.5kΩ or 2kΩ for proper operation of U2.

t. If the 5 MHz or 1 MHz markers are absent, check pin 9 of U9, U4, and their components.

u. If the 1 MHz markers are absent, check pin 8 of U3, U4, and their components.

v. To replace the Marker Section, do the following:

1. Remove nut from EXT RF MKR IN jack on 640G front panel.
2. Remove EXT RF MKR IN cable from 640G front panel.
3. Plug in the new Marker Section to the RF Section.
4. Insert and tighten the two screws in the overlapping bottom plate on Marker Section side of the RF Marker subassembly.
5. Plug in the subassembly to the 640G PC board.
6. Install and secure the eight screws in the top and bottom extrusions of the 640G.
7. Install the EXT RF MKR IN cable of the new Marker Section in the 640G front panel.
8. Install and tighten the nut on the EXT RF MKR IN jack on the 640G front panel.

4-4 640E LOG PLUG-IN ADJUSTMENTS

4-4.1 Power Supply Adjustments

NOTE

Unless otherwise noted, use TP8 as reference ground (Figure 4-9).

a. Connect the log plug-in to the left plug-in compartment through an extender cable.

b. On the 640E, do the following:

1. Connect DVM to TP6 and adjust -15V Adj R144 until DVM reads -15V ±1mV (Figure 4-9).
2. Connect DVM to TP7 and check that the voltage is +15V ±300mV (Figure 4-9).

4-4.2 Preamplifier Balance Adjustments

NOTE

The Preamplifier Balance Adjustments should be completed only when either U1, U5, U7, U10, or U16 is replaced.

a. On the 640E, do the following:

1. Connect a Model 7 Series RF Detec-

Figure 4-9. Log Plug-In PC Assembly

tor to the INPUT connector. Do not connect the other end of the RF detector to the 640G.

2. Place a temporary jumper between TP12 and TP13 (Figure 4-9).

NOTE

Accurate voltage readings occur only during the sweep portion of the display trace.

3. Connect DVM to the following test points in Table 4-6 and adjust the appropriate potentiometer for the proper reading (refer to Figure 4-9 for location of test points).

Table 4-6. 640E Preamplifier Adjustments and Voltages

Test Point	Adjustment	Reading (Vdc)
TP4	R21	0 ±2mV
TP3	R123	0 ±50μV
TP2	R75	0 ±30μV
TP1	R46	0 ±10μV

4. Repeat step 3.

5. Disconnect jumper between TP12 and TP13.

4-4.3 Output Amplifier Adjustments

a. On the 640E, do the following:

1. Set +/- switch to + (positive).

2. Adjust OFFSET dB until counter indicates 00.0.

b. On the 640G, do the following:

1. Set CENTER FREQUENCY, MHz control to 750.

2. Set SWEEP WIDTH to CW.

3. Set SWEEP RATE switch to SLOW.

4. Set SWEEP RATE control fully CCW.

5. Set TRIGGER to EXT.

6. Set RF OUT dBm to 0.

7. Connect power meter to RF OUTPUT connector.

8. Adjust RF OUT Vernier so the power meter reads 0 dBm.

9. Set TRIGGER to AUTO.

10. Connect Model 7 Series RF Detector between the RF OUT connector and the RF INPUT connector of the 640E.

c. On the 640E, do the following:

1. Push in the ON button.

2. Connect the DVM between terminal F and TP9 (Figure 4-9).

3. Adjust Zero R133 until DVM measures 0 ±100μV (Figure 4-9).

4. Adjust OFFSET dB until counter indicates 10.0.

5. Adjust +Dial Tracking R71 until DVM reads 1V ±1mV (Figure 4-9).

6. Adjust OFFSET dB until counter indicates 25.0.

7. Set +/- switch to - (minus).

8. Adjust -Dial Tracking R72 until DVM reads -2.5V ±1mV (Figure 4-9).

4-4.4 100mV/dBm and 0 dBm Offset Adjustments

a. On the 640E, do the following:

1. Adjust OFFSET dB until counter reads 00.0.

2. Connect DVM between TP16 and TP8 (Figure 4-9).

3. Adjust 0 dBm Offset R43 until DVM reads 0 ±5mV (Figure 4-9).

NOTE

Be sure that the RF OUT Vernier is not moved during the following steps.

b. On the 640G, set RF OUT dBm to -10.

c. On the 640E, do the following:

1. Adjust 100mV/dBm Adj R51 until

DVM reads -1V ±5mV (Figure 4-9).

2. Adjust DISPLAY POSITION to place the retrace near the center of the CRT.

d. Set 640G RF OUT dBm and 640E OFFSET dB controls to each setting in Table 4-7. Adjust OFFSET dB until the RF trace is exactly on top of the retrace line. Check that the OFFSET counter indication is within tolerance; if not, repeat steps a through c.

Table 4-7. 640E Log Conformity Tolerances

RF OUT dBm	OFFSET +/-	Counter Tolerance
+10	10.0 + (1)	±0.2
0	00.0 + (1)	±0.2
-10	10.0 -	±0.3
-20	20.0 -	±0.4
-30 (2)	30.0 -	±0.5
-40 (2)	40.0 -	±0.6
-50 (2)	50.0 -	±0.7

(1) At 0 dBm, when the +/- is in either position, the RF trace should move less than one minor division when the dB/DIV switch is set to .2.

(2) In the MIN or MAX position, the SMOOTHING switch can filter noise from the RF trace at RF power levels of -40 dBm or below.

e. On the 640G, do the following:

1. Set RF OUT dBm to +10.
2. Connect power meter to RF OUT connector.
3. Set SWEEP WIDTH switch to CW.
4. Set TRIGGER to EXT.
5. Set CENTER FREQUENCY, MHz to 100 and note the reading on power meter.
6. Set CENTER FREQUENCY, MHz to 1500 and note the reading on power meter.
7. Repeat steps 5 and 6 while adjusting SLOPE control for equal power meter readings.
8. Set SWEEP WIDTH switch to FULL.
9. Connect Model 7 Series Detector between RF OUT connector and 640E RF INPUT connector.
10. Set TRIGGER to AUTO.

f. On the 640E, do the following:

1. Push in the ON button.
2. Adjust DISPLAY POSITION control to place retrace near the center of the CRT.
3. Adjust OFFSET dB so counter indicates 10.0.
4. Adjust Det Slope R31 so the ends of the RF trace are at the same vertical level on the CRT (Figure 4-9).

4-5 640L LINEAR PLUG-IN ADJUSTMENTS

4-5.1 Power Supply Adjustments

NOTE

Use TP8 as reference ground for all measurements.

a. On the 640L, do the following:

1. Connect the linear plug-in to the center or left compartment through an extender cable.
2. Connect DVM to TP6 (Figure 4-10).
3. Adjust -15V Adjust R144 until the DVM indicates -15V ±300mV (Figure 4-10).
4. Connect DVM to TP7 (Figure 4-10).
5. Check that DVM reads +15V ±300mV.

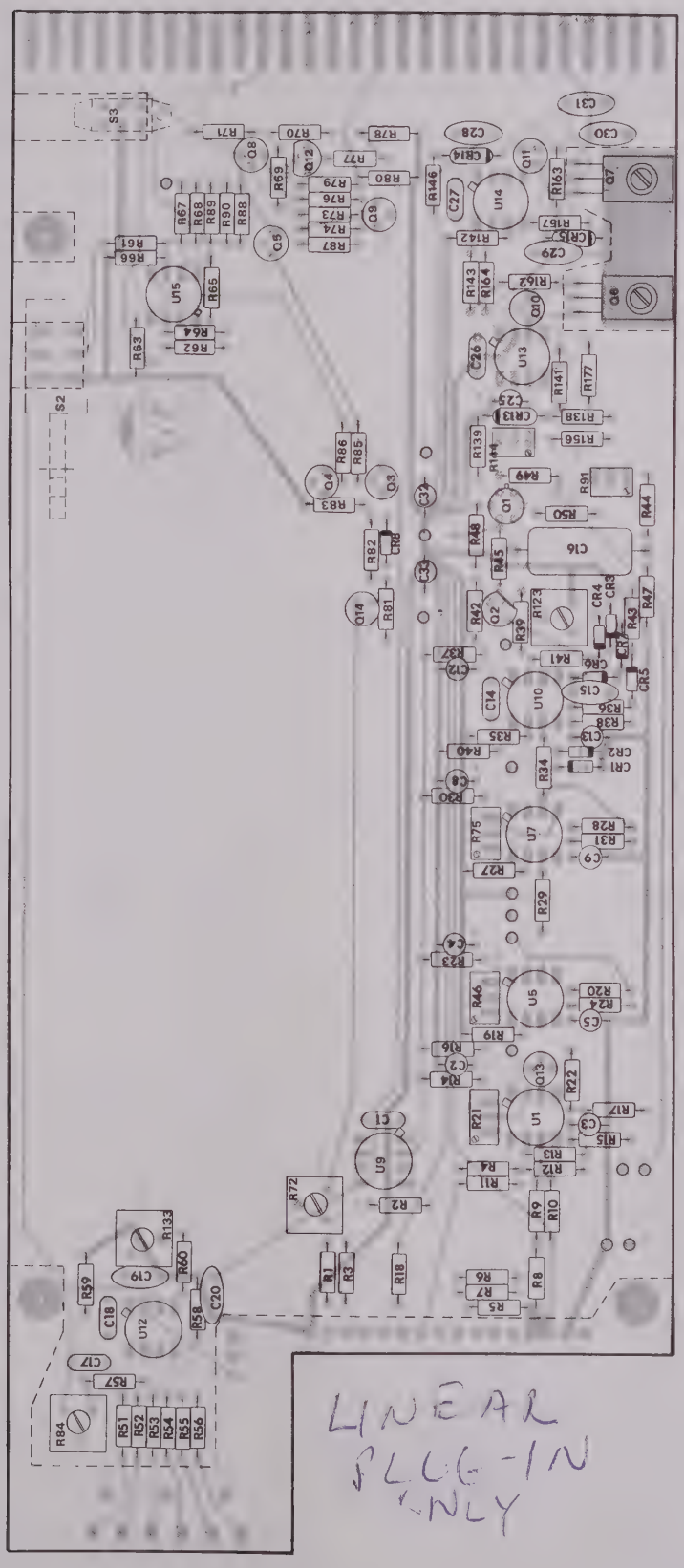


Figure 4-10. Linear Plug-In PC Assembly

4-5.2 Preamplifier Adjustments

NOTE

These adjustments should only be necessary when either U1, U5, U7, or U10 is replaced.

a. On the 640G, do the following:

1. Set SWEEP RATE to SLOW.
2. Adjust SWEEP RATE control fully CCW.
3. Set TRIGGER to AUTO.

b. On the 640L, do the following:

1. Connect a temporary jumper between TP12 and TP13.
2. On the bottom side of the PC board, set Auto Null to On (Figure 4-10).
3. Connect DVM to each test point in Table 4-8 and perform the necessary adjustment (see Figure 4-10 for location of the potentiometers).

NOTE

Make voltage reading only during the sweep portion of the display trace.

4. Repeat step 3 until voltages are within tolerance.

Table 4-8. 640L Preamplifier Adjustments and Voltages

Test Point	Adjust	Reading (Vdc)
1	R46 Bal 2	0 ± 10μV
2	R75 Bal 3	0 ± 10μV
3	R123 Bal 4	0 ± 100μV
15	R91 Bal 5	0 ± 1mV
5	R21 Bal 1	0 ± 1mV

4-5.3 Output Amplifier Adjustments

a. On the 640L, do the following:

1. Connect DVM to TP9 (Figure 4-10).
2. Press in ON button.
3. Adjust OFFSET, mV until counter reads 000.
4. Adjust Bal 6 R133 until DVM reads 0 ± 1mV (Figure 4-10).
5. Remove temporary jumper from TP12 and TP13.
6. Set Auto Null S3 to Off.

b. On the power supply, adjust the Output Voltage for 1V ± 10μV.

c. On the 640L, do the following:

1. Set INPUT switch to + (positive).
2. Set mV/DIV to 250.
3. Connect DVM to TP9 (Figure 4-10).
4. Adjust Gain Cal R84 until DVM reads +4V ± 100μV (Figure 4-10).

d. Set power supply and counter to each setting in Table 4-9. Check that the counter indication is within tolerance; if not, repeat steps a, b, and c.

Table 4-9. 640L Linear Conformity Tolerances

Power Supply (mV)(1)	Input	Counter	Tolerance (mV)
+100	+	100	±1
+300	+	300	±3
+500	+	500	±5
+800	+	800	±8
+1000	+	1000	±10
-100	-	100	±1
-300	-	300	±3
-500	-	500	±5
-800	-	800	±8
-1000	-	1000	±10

(1) Power supply output must be within ±0.5mV.

4-6 640R LOG PLUG-IN ADJUSTMENTS

4-6.1 Power Supply Adjustments

NOTE

Unless otherwise noted, use TP8 (Figure 4-9) as reference ground.

a. Connect log plug-in to the left plug-in compartment through an extender cable.

b. On the 640R, do the following:

1. Connect DVM to TP6 and adjust -15V Adj R144 until DVM reads -15V ±1mV (Figure 4-9).

2. Connect DVM to TP7 and check that the voltage is +15V ±300mV (Figure 4-9).

4-6.2 Preamplifier Balance Adjustments

NOTE 1

The Preamplifier Balance adjustments should be completed only when either U1, U5, U7, U10, or U16 is replaced.

NOTE 2

Accurate voltage readings occur only during the sweep portion of the display trace.

a. On the 640R, do the following:

1. Connect a temporary jumper between TP12 and TP13 (Figure 4-9).

2. Connect DVM to the test points in Table 4-10 and adjust the appropriate potentiometer for the proper reading (see Figure 4-9 for the location of the test points and adjustments).

Table 4-10. 640R Preamplifier Adjustments and Voltages

Test Point	Adjustment	Reading (Vdc)
TP4	R21	0 ± 2mV
TP3	R123	0 ± 50μV
TP2	R75	0 ± 30μV
TP1	R46	0 ± 10μV

3. Repeat step 2. OK FIRST STAGE WILL BE OFF

4. Disconnect temporary jumper between TP12 and TP13.

5. Connect a temporary jumper between PC board terminal 19 and TP8 (Figure 4-9).

4-6.3 Output Amplifier Adjustments

a. On the 640R, adjust OFFSET dB until counter indicates 00.0.

b. On the 640G, do the following:

1. Set CENTER FREQUENCY, MHz control to 750.

2. Set SWEEP WIDTH to 1.

3. Set SWEEP RATE switch to SLOW.

4. Rotate SWEEP RATE control fully CCW.

5. Set RF OUT to 0.

6. Connect power meter to RF OUT connector.

7. Adjust RF OUT Vernier so the power meter reads 0 dBm.

8. Connect a cable between the RF OUT connector and the 640R RF INPUT connector.

c. On the 640R, do the following:

1. Push in the ON button.
10 dB/DIV
2. Connect DVM between terminal F and TP9 (Figure 4-9). SEE NOTE P6-23.

3. Remove jumper between PC board terminal 19 and TP8.

3A. connect jumper fr... TP, ... OR FROM WHERE IT OF ZERO DB SET POT TO IT

P.S. THE OTHER BOOK ON P6-16, STEP 17 C, WHICH IS SIMILAR TO STEP 4-6.3C IN THIS BOOK, THEY GND THE ZERO DB INPUT, WHICH IS THE SAME AS ...

4, c. HIGH IS ± OR THIS ALSO.

4. Adjust Zero R133 until DVM measures -.200V ±100μV (Figure 4-9).

5. Adjust OFFSET dB until counter indicates 10.0.

6. Adjust -Dial Tracking R72 until DVM reads -1.2V ±1mV (Figure 4-9).

4-6.4 100mV/dBm and 0 dBm Offset Adjustments

a. On the 640G, set RF OUT dBm to 0.

b. On the 640R, do the following:

1. Adjust OFFSET dB until counter reads 00.0.

2. Connect DVM between TP16 and TP8 (Figure 4-9).

3. Adjust 0 dBm Offset R43 until DVM reads -1.2V ±5mV.

NOTE

Be sure that the RF OUT Vernier is not moved during the following steps.

c. On the 640G, set RF OUT dBm to -10.

d. On the 640R, do the following:

1. Adjust 100mV/dBm Adj R51 until DVM reads -2.2V ±5mV (Figure 4-9).

2. Adjust DISPLAY POSITION to place retrace near the center of the CRT.

e. Set 640G RF OUT and 640R OFFSET dB controls to each setting in Table 4-11. Adjust OFFSET dB so the RF trace is exactly on top of the retrace line. Check that the OFFSET counter indication is within tolerance; if not, repeat steps b through d.

f. On the 640G, do the following:

1. Set RF OUT dBm to +10.

2. Connect power meter to RF OUT connector.

Table 4-11. 640R Log Conformity Tolerances

RF OUT dBm	OFFSET	Counter Tolerance
+10	00.0	Reference
0	10.0	±0.3
-10	20.0	±0.6
-20	30.0	±0.8
-30	40.0	±1.0
-40 (1)	50.0	±1.2
-50 (1)	60.0	±1.4

(1) In the MIN or MAX position, the SMOOTHING switch can filter noise from the RF trace at an RF power level of -40 dBm or lower.

3. Set SWEEP WIDTH switch to CW.

4. Set CENTER FREQUENCY, MHz to 100 and note the reading on power meter.

5. Set CENTER FREQUENCY, MHz to 1500 and note the reading on power meter.

6. Repeat steps 4 and 5 while adjusting SLOPE control for equal power meter readings.

7. Set SWEEP WIDTH switch to FULL.

8. Connect a cable between RF OUT connector and 640R RF INPUT connector.

g. On the 640R, do the following:

1. Push in the ON button.

2. Adjust DISPLAY POSITION control to place retrace near the center of the CRT.

3. Adjust OFFSET dB so counter indicates 10.0.

4. Adjust Det Slope R31 so the ends of the RF trace are at the same vertical level on the CRT (Figure 4-9).

4-7 640T LOG PLUG-IN ADJUSTMENTS

4-7.1 Power Supply Adjustments

NOTE

Unless otherwise noted, use TP8 as reference ground (Figure 4-9).

a. Connect log plug-in to the left plug-in compartment through an extender cable.

b. Connect DVM to TP6 and adjust -15V Adj R144 until DVM reads -15V ±1mV (Figure 4-9).

c. Connect DVM to TP7 and check that the voltage is +15V ±300mV (Figure 4-9).

4-7.2 Preamplifier Balance Adjustments

NOTE

The Preamplifier Balance Adjustments should be completed only when either U1, U5, U7, U10, or U16 is replaced.

a. Place a temporary jumper between TP12 and TP13 (Figure 4-9).

NOTE

Accurate voltage readings occur only during the sweep portion of the display trace.

b. Connect DVM to the test points in Table 4-12 and adjust the appropriate potentiometer for the proper reading.

Table 4-12. 640T Preamplifier Adjustments and Voltages

Test Point	Adjustment	Reading (Vdc)
TP4	R21	0 ±2mV
TP3	R123	0 ±50μV
TP2	R75	0 ±30μV
TP1	R46	0 ±10μV

c. Repeat step b. OR FIRST STAGE WILL BE OFF

d. Disconnect jumper between TP12 and TP13.

4-7.3 Output Amplifier Adjustments

a. On the 640T, do the following:

1. Set +/- switch to + (positive).
2. Adjust OFFSET dB until counter indicates 00.0.

dB/DIV TO 10? YES!

b. On the 640G, do the following:

1. Set CENTER FREQUENCY, MHz control to 750.
2. Set SWEEP WIDTH to CW.
3. Set SWEEP RATE switch to SLOW.
4. Set SWEEP RATE control fully CCW.
5. Set RF OUT dBm to 0.
6. Set TRIGGER to EXT.
7. Connect power meter to RF OUTPUT connector.
8. Adjust RF OUT Vernier so the power meter reads 0 dBm.
9. Connect a cable between the RF OUT connector and the RF INPUT connector of the 640T.
10. Set TRIGGER to AUTO.

c. On the 640T, do the following:

1. Push in the ON button.
2. Connect DVM between terminal F and TP9 (Figure 4-9). (Hi lead to
3. Adjust Zero R133 until DVM measures 0 ± 100μV (Figure 4-9).
4. Adjust OFFSET dB until counter indicates 10.0.
5. Adjust +Dial Tracking R71 until DVM reads 1V ±1mV (Figure 4-9).
6. Adjust OFFSET dB until counter indicates 25.0.
7. Set +/- switch to - (minus).
8. Adjust -Dial Tracking R72 until DVM reads -2.5V ±1mV (Figure 4-9).

USE SUCH-HI INPUT R METER LIKE 3840 OR YOU INDUCE ERROR.

4-7.4 100mV/dBm and 0 dBm Offset Adjustments

NOTE

Be sure that the RF OUT Vernier is not moved in the following steps.

a. On the 640T, do the following:

1. Adjust OFFSET dB until counter reads 00.0.
2. Connect DVM between TP16 and TP8 (Figure 4-9).
3. Adjust 0 dBm Offset R43 until DVM reads 0 ±5mV (Figure 4-9).

b. On the 640G set RF OUT dBm to -10.

c. On the 640T, do the following:

1. Adjust 100mV/dBm Adj R51 until DVM reads -1V ±5mV (Figure 4-9).
2. Adjust DISPLAY POSITION to place the retrace near the center of the CRT.

d. Set 640G RF OUT dBm and 640T OFFSET dB controls to each setting in Table 4-13. Adjust OFFSET dB so the RF trace is exactly on top of the retrace line. Check that the OFFSET counter indication is within tolerance; if not, repeat steps a and b.

e. On the 640G, do the following:

1. Set RF OUT dBm to +10.
2. Connect power meter to RF OUT connector.
3. Set SWEEP WIDTH switch to CW.
4. Set CENTER FREQUENCY, MHz to 100 and note the reading on power meter.
5. Set CENTER FREQUENCY, MHz to 1500 and note the reading on power meter.
6. Repeat steps 4 and 5 while adjusting SLOPE control for equal power meter readings.
7. Set SWEEP WIDTH switch to FULL.
8. Connect a cable between RF OUT connector and 640T RF INPUT connector.

f. On the 640T, do the following:

1. Push in the ON button.
2. Adjust DISPLAY POSITION control to place retrace near the center of the CRT.
3. Adjust OFFSET dB so counter indicates 10.0.
4. Adjust Det Slope R31 so the ends of the RF trace are at the same vertical level on the CRT (Figure 4-9).

Table 4-13. 640 T Log Conformity Tolerances

RF OUT dBm	OFFSET +/-	Counter Tolerance
+10	10.0 + (1)	±0.2
0	00.0 + (1)	±0.2
-10	10.0 -	±0.3
-20	20.0 -	±0.4
-30 (2)	30.0 -	±0.5
-40 (2)	40.0 -	±0.6
-50 (2)	50.0 -	±0.7

(1) At 0 dBm, when the +/- is in either position, the RF trace should move less than one minor division when the dB/DIV switch is set to .2.

(2) In the MIN or MAX position, the SMOOTHING switch can filter noise from the RF trace at RF power levels of -40 dBm or below.

4-8 DIODE REPLACEMENT, INTERNAL AND EXTERNAL RF COMPONENTS

The 640R SWR Autotester, Model 6 Series SWR Autotester, 640T RF Detector, and Model 7 Series RF Detector contain a replaceable diode.

NOTE

If the diode in the RF detector is being replaced, a power meter is required for calibration.

4-8.1 Diode Replacement for SWR Autotesters

a. If SWR Autotester is a Model 6 Series SWR Autotester, remove the two screws from the SWR Autotester and the covers.

b. If the SWR Autotester is a 640R SWR Autotester, do the following:

1. Remove the left side panel of the 640R.
2. Locate and remove the two screws from the SWR Autotester.

c. Unplug the diode from the SWR Autotester.

d. Install the new diode with its cathode positioned as shown in Figure 4-11.

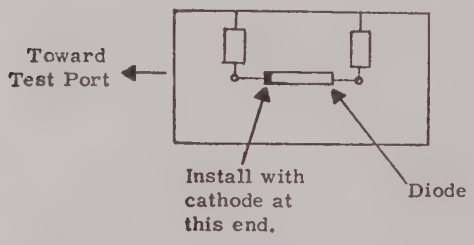


Figure 4-11. Diode Installation in SWR Autotester

e. Attach the cover to the SWR Autotester and secure it with the two screws.

4-8.2 Diode Replacement for RF Detectors

a. If the RF detector is a Model 7 Series RF Detector, remove the two screws and the cover.

b. If the RF detector is a 640T RF Detector, do the following:

1. Remove the left side panel of the 640T.
2. Locate and remove the two screws from the RF detector.

c. Unplug the diode from the RF detector.

d. Install the new diode with its cathode positioned as shown in Figure 4-12.

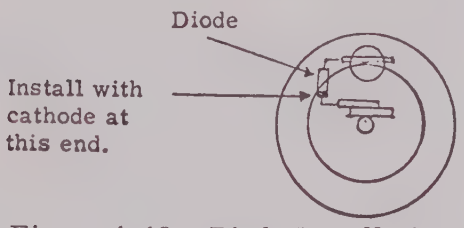


Figure 4-12. Diode Installation in RF Detector

e. If the RF detector is a Model 7 Series RF Detector, leave the cover off.

f. If the RF detector is a 640T RF Detector, do the following:

1. Secure the cover to the RF detector with the two screws.
2. Place the left side panel on the 640T.
3. Remove the right side panel from the 640T.
4. Connect the 640T to the left plug-in compartment through an extender cable.

g. On the log plug-in, set the front panel controls as follows:

dB/DIV:	.2
DISPLAY POSITION:	As desired
dBm/dB:	dBm
OFFSET:	10.0
+/-:	+ (positive)
SMOOTHING:	OFF

h. On the 640G, do the following:

1. Set front panel controls as follows:

SWEEP RATE:	MANUAL
TRIGGER:	EXT
SWEEP WIDTH:	CW
CENTER FREQUENCY, MHz:	750
RF OUT dBm:	+10
RF OUT Vernier:	3 o'clock position

2. Connect the power meter to RF OUT connector.

3. Adjust RF OUT Vernier until power meter reads exactly +10 dBm.

4. Disconnect power meter from RF OUT connector.

i. If the RF detector is a Model 7 Series RF Detector, connect it between the RF OUT connector of the 640G and the RF INPUT connector of the 640E.

j. If the RF detector is in the 640T, connect a short cable between the RF OUT connector of the 640G and the RF INPUT connector of the 640T.

k. Check that the RF trace is exactly on top of the reference trace. If the RF trace is not exactly on top of the reference trace, do the following:

1. If the RF detector is a Model 7 Series RF Detector, adjust the trimmer potentiometer in the RF detector until the RF trace is exactly on top of the retrace.

2. If the RF detector is in the 640T, locate and adjust -30 dBm Cal R4 until the RF trace is exactly on top of the retrace (Figure 4-9).

HOW TO USE TROUBLESHOOTING CHART

1. Perform each sub-step in the "Procedure" column and then refer to the "Results" column. If the result is normal, proceed to the next step. If the result is abnormal, refer to the "Notes" column for further instructions.

2. Perform each step in sequence until the trouble is found.

3. Refer to the schematic diagram listed in the "Schematic Reference" column to aid troubleshooting.

4. In some steps, reference is made to steps in the Maintenance section. These steps in the Maintenance section must be completed before continuing the troubleshooting steps.

Table 4-3. CRT Beam and Sweep Ramp Checks

STEP	PROCEDURE	RESULT	NOTES	SCHEMATIC REFERENCE
1	Place log plug-in in left compartment. Set front panel controls as follows: ±: + OFFSET dB: 0.00 ON: Out position dBm/dB: dBm dB/DIV: 10 SMOOTHING: OFF			
2	Pull out POWER switch.	ON lamp is lit.	If no ON lamp nor dot, check fuse on rear panel of mainframe, line selector block (Figure 1-6) and thermal breaker, S200. If fuse, line selector block and thermal breaker are good, check LV power supply.	Figure 6-2
3	Press BEAM FINDER button.	Dot appears on screen.	If ON lamp is lit but no dot, check Beam Finder circuit, HV power supply and CRT.	Figures 6-3, 6-4
4	Hold in BEAM FINDER and adjust the FOCUS control.	Focus to fine dot and check the roundness throughout range of FOCUS control.	If dot does not stay round, perform adjustments in paragraph 4-2.3.	Figure 6-3
5	Hold in BEAM FINDER and run the DISPLAY POSITION to both ends.	Dot moves to top and to bottom, but stays on the screen.	If dot doesn't move, try other log plug-in. If dot still doesn't move, fault is in mainframe.	Mainframe: Figures 6-3, 6-4 Log Plug-In: Figure 6-14 Figures 6-2, 6-3
6	Hold in BEAM FINDER and use the DISPLAY POSITION to center dot vertically.		If dot goes off screen, fault is in Beam Finder circuit or in CRT deflection circuit.	
7	Set POWER switch to off. Put 640G in right plug-in compartment. Set front panel controls as follows: CENTER FREQUENCY, MHz: 0 Vernier: Straight up MARKER SPACING: OFF SWEEP WIDTH: FULL SWEEP RATE: FAST Vernier: Fully CW TRIGGER: AUTO WIDTH VERNIER: Fully CW RF OUT dBm: 0 Vernier: 3 o'clock position Power: On			
8	Turn INTENS control CW and then CCW.	Horizontal trace appears and then disappears.	If INTENS control does not turn off beam, Beam Finder circuit needs adjustment. Perform adjustments in paragraph 4-2.3. If horizontal trace does not appear, connect cable from HORIZONTAL OUT on rear panel to scope. If 0 to 10V ramp does not appear on scope, trouble is in 640G. If a 0 to 10V ramp appears, trouble is in mainframe.	640G: Figures 6-6, 6-7 Mainframe: Figures 6-1, 6-4

Table 4-3. CRT Beam and Sweep Ramp Checks (Continued)

STEP	PROCEDURE	RESULT	NOTES	SCHEMATIC REFERENCE
9	Check that trace is horizontal.	Trace is parallel to graticule line.	If trace is tilted, adjust TRACE ROTATION (rear panel).	
10	Check length of trace.	Trace extends one trace thickness beyond graticule on left and right sides.	If trace is not the proper length, perform adjustments in paragraph 4-2.5. If adjustments in paragraph 4-2.5 are made, perform the adjustments in paragraph 4-3.3.	Figures 6-1, 6-4 Figure 6-7
11	Set TRIGGER to LINE.	Trace continues to appear.	If no sweep in LINE, check Ramp Generator in 640G.	Figure 6-6
12	Set TRIGGER to EXT. Press the SINGLE SWEEP button.	A single sweep occurs.	If no single sweep occurs, short the center pin of the rear panel EXT TRIGGER IN connector to ground. If this produces a sweep, then S4 is defective; if not, then trouble is in the Ramp Generator circuit. Check U18.	Figure 6-6
13	Return TRIGGER to AUTO position.			
14	Set SWEEP RATE to FAST and vernier fully CCW.	Sweep takes about 2 seconds (±20%).	If sweep rate is off, fault is in sweeper plug-in.	Figure 6-6
15	Set SWEEP RATE to SLOW and vernier fully CW.	Sweep takes about 2 seconds (±20%).	If sweep rate is off, fault is in sweeper plug-in.	Figure 6-6
16	Turn vernier fully CCW.	Sweep takes from 80 to 120 seconds.	If sweep rate is off, fault is in sweeper plug-in.	Figure 6-6
17	Set SWEEP RATE to MANUAL, vary vernier from CW to fully CCW.	Dot moves from far right to far left of screen.	If vernier does not move the dot across the entire length of the screen, make adjustments listed in paragraph 4-3.3.	Figure 6-7
18	Return SWEEP RATE to FAST, and vernier to fully CW.			
19	Plug in second log plug-in. Adjust DISPLAY POSITION control on second plug-in.	Two traces appear simultaneously.	If no second trace appears, place another log plug-in in the compartment. If trace is still missing, trouble is probably in the Chopper circuit of the mainframe. If trace appears with another log plug-in, trouble is in the log plug-in.	Mainframe: Figure 6-5 Log Plug-In: Figure 6-16
20	Remove second log plug-in.			

Table 4-4. Marker, Sweep Width and Linearity Checks

STEP	PROCEDURE	RESULT	NOTES	SCHEMATIC REFERENCE
21	Set sweeper RF OUT dBm to -20. Check that log plug-in ON switch is in the out position.			
22	Set SWEEP WIDTH to FULL and MARKER SPACING to 100. Check operation of AMPL and TILT controls.	AMPL varies marker amplitude from zero to about 0.4 division; the TILT control varies marker angle about ±45 degrees.	If no markers appear, change log plug-ins. Then, if no markers appear, trouble is probably in 640G.	Log Plug-In: Figure 6-16 640G: Figures 6-7, 6-9

Table 4-4. Marker, Sweep Width and Linearity Checks (Continued)

STEP	PROCEDURE	RESULT	NOTES	SCHEMATIC REFERENCE
23	Check that 15 markers appear on the trace.	The 15th marker should be on top of the far-right vertical graticule line.	If wrong number of markers or incorrectly spaced markers appear, perform adjustments in paragraph 4-3.8.	Figure 6-8
24	Vary CENTER FREQUENCY control from 0 to 1500 MHz.	Center Frequency marker moves across the trace.	If marker does not move across the length of the trace, check Center Frequency, MHz circuitry.	Figure 6-7
25	Set SWEEP WIDTH and MARKER SPACING both to 100. Set CENTER FREQUENCY control to 500.			
26	Adjust CENTER FREQUENCY, MHz Vernier to center 500 MHz marker on top of the center vertical graticule line.	Check that markers appear at each major division, ± one small division.	If the 0 to 1000 MHz markers are out-of-spec, perform the adjustments in paragraph 4-3.8.	Figure 6-8
27	Set CENTER FREQUENCY, MHz so 1000 MHz marker is in the center of the graticule.	Check that markers appear at each major division, ± one small division.	If the 500 to 1500 MHz markers are out-of-spec, perform the adjustments in paragraph 4-3.8.	Figure 6-8
28	Set CENTER FREQUENCY, MHz to each 100 MHz marking on the dial from 0 to 1500 MHz.	Check that 100 MHz marker remains within ±35 MHz of center line of graticule. (It may be convenient to set SWEEP WIDTH to 25 MHz.)	If out-of-spec, perform the adjustments in paragraph 4-3.9.	Figure 6-7
29	Set MARKER SPACING to 1. Set SWEEP WIDTH to 1.	Check that a) 1 MHz markers are within one major division (±1 MHz) of correct position, and b) that the markers are four tiers high.	If center marker is not 4 tiers high, change both the SWEEP WIDTH and MARKER SPACING and check that all markers are present. If not, trouble is in Marker Generator circuit.	Figure 6-9.
30	Vary setting of MARKER WIDTH.	Marker width varies.	If width of marker does not change, the fault is probably in the Marker Section.	Figure 6-9
31	Set SWEEP WIDTH to 5 and MARKER SPACING to 1. Run WIDTH VERNIER control fully CCW.	Note that the markers disappear.	If the markers do not disappear, fault is probably R2 in the Frequency Instruction circuit.	Figure 6-7
32	Set 640G front panel controls as follows: CENTER FREQUENCY, MHz: 100 Vernier: Straight up MARKER SPACING: OFF SWEEP WIDTH: FULL SWEEP RATE: FAST Vernier: Fully CW TRIGGER: AUTO WIDTH VERNIER: Fully CW RF OUT dBm: 0 Vernier: Fully CW		If the system has two log plug-ins, both should be plugged in.	

Table 4-5. Attenuator, Offset, Power Tests

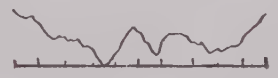
STEP	PROCEDURE	RESULT	NOTES	SCHEMATIC REFERENCE
33	If the system has 640R and 640T plug-ins, the 640T is checked first and then the 640R is checked. After the first log plug-in is checked, repeat the following steps to check the second log plug-in.			
34	Set log plug-in controls as follows: ±: + OFFSET dB: 10.0 ON: Out position dBm/dB: dBm dB/DIV: .5 SMOOTHING: OFF DISPLAY POSITION: As desired On second log plug-in, turn DISPLAY POSITION control fully CCW.			
35	If log plug-in is a 640T, connect a short cable from 640G RF OUT connector to 640T RF INPUT connector.			
36	If log plug-in is a 640E, connect a Model 7 Series RF Detector between the 640G RF OUTPUT connector and the 640E RF INPUT connector.			
37	Press in the ON button (only on the log plug-in under test).	RF trace appears.	Use BEAM FINDER and OFFSET dB controls to locate RF trace. If it is found below noise level (<-50 dBm), there may be no RF from 640G (use another log plug-in to check for RF output).	
38	Use SLOPE control to obtain best leveling of trace. 	SLOPE control should have sufficient range to change slope of detected RF. SLOPE control should be adjusted so point a and point b are at the same level.	If SLOPE control does not work or has insufficient range, trouble is probably in the ALC section of 640G.	Figure 6-10
39	Use the OFFSET dB controls to lay the lowest point of the trace on the reference line. 	OFFSET counter should read +10.5 ±0.3 dB (this assumes the log plug-in is paired with the same RF detector used in the original calibration).	If calibration is off, perform adjustments in paragraph 4-3.5. (This assumes that a) the log plug-in is calibrated and b) the Det Slope R31 adjustment in the log plug-in is correctly set. If there is any question about the 640G RF output, check it with a power meter).	Figure 6-16
40	Set OFFSET dB to 00.0. Turn RF OUT Vernier CCW to align the lowest point of the RF trace on top of the retrace.	Largest excursion of RF power from reference should not exceed ±0.3 dB.	If calibration is off, perform adjustments in paragraph 4-3.5. If adjustments do not correct the fault, change log plug-ins and repeat steps 36 through 47. If new log plug-in is within tolerance, the fault is in the other log plug-in. Perform adjustments in paragraphs 4-4.3 and 4-4.4 on the other log plug-in. If both log plug-ins are out-of-calibration, fault is probably in the ALC section of 640G.	640G: Figure 6-10 Log Plug-In: Figure 6-16

Table 4-5. Attenuator, Offset, Power Tests (Continued)

STEP	PROCEDURE	RESULT	NOTES	SCHEMATIC REFERENCE
41	Use CENTER FREQUENCY dial to set the variable marker on lowest part of trace (where it touches reference line).			
42	Set SWEEP WIDTH to 1 and SWEEP RATE to SLOW. Set the sweep rate Vernier for a sweep of approximately 20 seconds. In the following checks, use trace for measurements (do not use retrace.)			
43	Change ± from + to -.	There should be no discernible shift in position of trace dot.	If there is a discernible shift, the fault is in R62, the OFFSET potentiometer.	Figure 6-16
44	Set the RF OUT dBm to each value in sequence as shown in table below. For each setting, use the OFFSET dB to realign trace with reference. The second column lists the tolerances. RF OUT dBm / OFFSET / dB/DIV +10 / +10 ±0.2 / .5 -10 / -10 ±0.3 / .5 -20 / -20 ±0.4 / .5 -30 / -30 ±0.6 / 1.0 -40 / -40 ±0.8 / 1.0* -50 / -50 ±1.0 / 2.0* *Set smoothing to maximum and find average with the noise.		If an out-of-spec condition occurs, leave RF OUT dBm at +10 and put precision attenuator in series between 640G and log plug-ins. Change attenuator in 10 dB steps, and correct trace movement with OFFSET dB as before, to determine whether error is in attenuator or in log plug-in OFFSET dB potentiometer.	640G: Figure 6-10 Log Plug-In: Figure 6-16
45	Return RF OUT dBm to 0. Return OFFSET dB to 00.0 and SMOOTHING to OFF on log plug-in.			
46	Set the dBm/dB switch to dB and use the ZERO dB SET control to re-zero trace.	Trace is realigned with the retrace.	If the ZERO dB SET control does not work properly, the fault is dBm/dB switch S4 or ZERO dB SET control R94.	Figure 6-16
47	Set dB/DIV switch to each value in sequence as shown below. For each value, set OFFSET dB to value shown in second column and change ± switch from + to -. dB/DIV / OFFSET dB 10 / ±40.0 5 / ±20.0 2 / ± 8.0 1 / ± 4.0 .5 / ± 2.0 .2 / ± 0.8	In each instance, trace moves to top and then to bottom line of the graticule. The tolerance is ± the thickness of the trace.	If unit does not meet specifications, perform adjustments in paragraph 4-2.4. If linearity is still off, or there is reason to question accuracy of dB/DIV switch, perform the adjustments in paragraphs 4-4.3 and 4-4.4.	

Table 4-6. 640L Linear Plug-In Checks

STEP	PROCEDURE	RESULT	NOTES	SCHEMATIC REFERENCE
48	Install the 640G in the right compartment and the 640L in the left compartment.			
49	Set 640G front panel controls as follows: CENTER FREQUENCY, MHz: 100 Vernier: Straight up MARKER SPACING: OFF SWEEP WIDTH: FULL SWEEP RATE: FAST Vernier: Fully CW TRIGGER: AUTO WIDTH VERNIER: Fully CW RF OUT dBm: -20 Vernier: 3 o'clock position			
50	Set 640L front panel controls as follows: mV/DIV: 1 INPUT: GND OFFSET, mV: 00.0 DISPLAY POSITION: As desired ON: Out position GAIN VERNIER: Fully CW		If trace does not appear or DISPLAY POSITION control does not operate, press BEAM FINDER switch on mainframe. If there is still no trace, the fault is in the 640L.	Figure 6-18
51	Set MARKER SPACING to 100 and set mainframe AMPL fully CW.	Markers appear.	If no markers appear (assuming that other amplifier plug-ins have passed this test), fault is in Marker Summing circuit of the 640L.	Figure 6-18
52	Set MARKER SPACING to OFF and SWEEP WIDTH to 1.			
53	Press in the ON button. Set Auto Null S3 on the 640L PC board to Off.	The trace does not deflect appreciably.	If trace deflection is appreciable, fault is in the 640L.	Figure 6-18
54	Connect DVM to power supply and set power supply output for 1V ±10μV.			
55	Set INPUT to + and connect INPUT DC COUPLED to power supply.			
56	Adjust OFFSET control for each input voltage level so the trace is on top of the reference trace. INPUT (mV) / OFFSET (mV) 1000 / 1000 ±10 100 / 100 ±1 10 / 10 ±0.1		If calibration is out of tolerance, perform the adjustments in paragraph 4-5.3.	Figure 6-18

SECTION V
REPLACEABLE PARTS LISTS

5-1 INTRODUCTION

This section of the manual contains alphanumeric listings of the replaceable parts available for the Model 640 RF Analyzer. These listings are by module or major subassembly, as shown in Table 5-1. Within each table parts are arranged by component type (i.e. Resistors, Capacitors, etc.).

Given in each listing are the reference designator, the part description, and the WILTRON part number. Items such as hardware, machined parts, etc., are not included although they may be ordered through us upon special request.

5-2 ORDERING REPLACEABLE PARTS

Parts for the Model 640 RF Analyzer may be ordered through your local WILTRON representative, or directly from:

WILTRON Company
825 East Middlefield Road
Mountain View, CA 94043

Telephone: (415) 969-6500
TWX: 910-379-6578

When ordering parts, give our representative complete information including the serial number of the instrument, reference designation, full part description, and the WILTRON part number.

Table 5-1. Parts List Organization

Table	Title	Page
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5-3.	640G Sweep Generator	5-15
5-4.	640G Sweep Generator PC Assembly 640-L-4626	5-16
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5-7.	640T Plug-In	5-23
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5-10.	Log PC Assembly 640-L-4625	5-25
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5-12.	Linear PC Assembly 640-L-6269	5-28

TABLE 5-2. 640 MAINFRAME

NOTE

Model 640 Mainframe replacement parts are available from WILTRON or through your local Tektronix, Inc., Field Office or representative.

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MURTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05574	VIKING INDUSTRIES, INC.	21001 NORDHOFF STREET	CHATSWORTH, CA 91311
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
10582	CTS OF ASHEVILLE, INC.	MILLS GAP ROAD	SKYLAND, NC 28776
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71450	CTS CORP.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
72136	ELECTRO MOTIVE CORPORATION, SUB OF INTERNATIONAL ELECTRONICS CORPORATION	SOUTH PARK AND JOHN STREETS	WILLIMANTIC, CT 06226
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76055	MALLORY CONTROLS, CO., DIV. OF MALLORY P. R., AND CO., INC.	STATE RD. 28 W., P O BOX 327	FRANKFORT, IN 46041
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81073	GRAYHILL, INC.	561 HILLGROVE AVE., PO BOX 373	LA GRANGE, IL 60525
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377

TABLE 5-2. 640 MAINFRAME (Continued)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number	WILTRON Part No.
A1	670-1433-00	B010100	B029999	CKT BOARD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670-1433-00	
A1	670-1433-01	B030000	B049999	CKT BOARD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670-1433-01	
A1	670-1433-02	B050000		CKT BOARD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670-1433-02	
A2	670-1454-00			CKT BOARD ASSY:SINGLE BEAM AUX	80009	670-1454-00	
A4	670-1339-00			CKT BOARD ASSY:LV POWER SUPPLY	80009	670-1339-00	
C106	283-0684-00	B010100	B049999	CAP.,FXD,MICA DI:620PF,20%,300V	00853	0153E621G0	
C106	283-0596-00	B050000		CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0	
C115	281-0027-00	B010100	B049999X	CAP.,VAR,PLSTC:0.7-3PF,350V	72982	535-0107-4R	
C116	283-0598-00	B010100	B049999	CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0	
C116	281-0180-00	B050000		CAP.,VAR,MICA D:18-115PF,175V	72136	T50607-2	
C126	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0	
C136	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F201F0	
C224	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J	
C227	281-0537-00			CAP.,FXD,CER DI:0.68PF,20%,600V	80009	281-0537-00	
C236	285-0526-00			CAP.,FXD,PLSTC:0.1UF.20%,400V	56289	410P10404	
C241	283-0270-00			CAP.,FXD,CER DI:6800PF,+80-20%,4000V	56289	45C17	
C242	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	56289	41C421	
C248	283-0270-00			CAP.,FXD,CER DI:6800PF,+80-20%,4000V	56289	45C17	
C249	283-0270-00			CAP.,FXD,CER DI:6800PF,+80-20%,4000V	56289	45C17	
C251	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4	
C252	283-0617-00			CAP.,FXD,MICA D:4700PF,10%,300V	00853	D193F472K0	
C253	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z	
C254	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038E105Z	
C258	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038E105Z	
C259	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M	
C272	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	848-556-Y5S-102M	
C273	283-0208-00			CAP.,FXD,CER DI:0.22UF,10%,200V	72982	8151N230 C 224K	
C274	283-0104-00	B010100	B039999	CAP.,FXD,CER DI:2000PF,5%,500V	72982	811-565B202J	
C274	283-0142-00	B040000		CAP.,FXD,CER DI:0.0027UF,5%,200V,(SEL)	72982	875-551B272J	
C279	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J	
C281	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z	
C622	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J	
C628	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J	
C632	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z	
C634	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J	
C636	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J	
C640	281-0519-00			CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K	
C642	281-0519-00			CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K	
C659	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P	
C671	281-0593-00	B010100	B029999X	CAP.,FXD,CER DI:3.9PF,10%,500V	72982	301-000C0J0399C	
C679	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P	
C712	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P	
C714	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J	
C716	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J	
C721	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J	
C810	290-0511-00			CAP.,FXD,ELCTLT:250UF,+75-10%,250V	56289	68D10464	
C815	290-0510-00			CAP.,FXD,ELCTLT:6000UF,+100-10%,15V	56289	66D10327	2000-45
C820	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2	
C822	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K	
C830	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301	
C837	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454	
C839	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454	
C842	290-0175-00			CAP.,FXD,ELCTLT:10UF,20%,35V	56289	150D106X0035R2	
C852	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373	
C857	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855558Z5U0103Z	
C860	290-0175-00			CAP.,FXD,ELCTLT:10UF,20%,35V	56289	150D106X0035R2	
C865	281-0550-00	B010100	B039999	CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373	
C865	281-0543-00	B040000		CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K	

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TABLE 5-2. 640 MAINFRAME (Continued)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number	WILTRON Part No.
C870	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2	
C872	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-000C0H0689D	
C875	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855558Z5U0103Z	
C881	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2	
C883	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2	
C890	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K	
CR209	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00	2000-49
CR211	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00	2000-49
CR214	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR215	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00	2000-49
CR224	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00	2000-49
CR239	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00	2000-49
CR241	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X	
CR247	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X	
CR253	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	80009	152-0414-00	
CR255	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR256	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00	2000-49
CR262	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR264	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR269	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00	2000-49
CR620	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR620	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR658	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR658	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR668	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR668	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR678	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR678	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR688	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR688	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR702	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR704	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR712	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR714	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR721	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR722	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR810	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00	
CR811	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00	
CR812	152-0107-00			SEMICOND DEVICE:SILICON.375V,400MA	80009	152-0107-00	
CR813	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00	
CR815	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00	2000-43
CR820	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00	
CR824	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR835	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00	
CR836	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00	
CR837	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00	2000-43
CR841	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00	
CR842	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00	
CR850	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR850	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR851	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR851	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR860	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00	
CR865	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR870	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR870	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR875	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR875	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR885	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152	
CR885	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	
CR890	151-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152	

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TABLE 5-2. 640 MAINFRAME (Continued)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number	WILTRON Part No.
DS271	150-0030-00			LAMP,GLOW:	08806	A2B-T	2000-46
DS272	150-0030-00			LAMP,GLOW:	08806	A2B-T	2000-46
DS273	150-0030-00			LAMP,GLOW:	08806	A2B-T	2000-46
F201[1]	159-0003-00			FUSE,CARTRIDGE:3AG,1.6A,250V,SLOW-BLOW	71400	MDX16-10	631-30
F201[2]	159-0019-00			FUSE,CARTRIDGE:3AG,1A,250V,SLOW BLOW	71400	MDL1	631-2
F810	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC 1/4	631-31
F835	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2	631-25
J210	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	24931	28JR200-1	
J601	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25	
J602	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25	
J603	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25	
J604	131-1043-00			CONNECTOR,RCPT,:18/36	05574	2VK18D/2-2	
L259	108-0564-00			COIL,RF:FIXED,74UH	80009	108-0564-00	
L291	108-0644-00			COIL,TUBE DEFLE:TRACE ROTATION	80009	108-0644-00	
Q104	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00	
Q104	151-0150-00	B080000		TRANSISTOR:SILICON,NPN	80009	151-0150-00	
Q106	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02	
Q106	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0190-00	
Q114	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00	
Q114	151-0150-00	B080000		TRANSISTOR:SILICON,NPN	80009	151-0150-00	
Q116	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02	
Q116	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0190-00	
Q124	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00	
Q124	151-0150-00	B080000		TRANSISTOR:SILICON,NPN	80009	151-0150-00	
Q126	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02	
Q126	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0190-00	
Q134	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00	
Q134	151-0150-00	B080000		TRANSISTOR:SILICON,NPN	80009	151-0150-00	
Q136	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02	
Q136	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0190-00	
Q138	151-0341-00	XB050000		TRANSISTOR:SILICON,NPN	07263	S040065	
Q214	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q222	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00	
Q226	151-0179-00	B010100	B069999	TRANSISTOR:SILICON,NPN	03508	X16X2069	
Q226	151-0347-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0347-00	
Q234	151-0228-00	B010100	B069999	TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00	
Q234	151-0350-00	B070000	B072987	TRANSISTOR:SILICON,PNP	80009	151-0350-00	
Q234	151-0406-00	B072988		TRANSISTOR:SILICON,PNP,SEL FROM 2N5401	80009	151-0406-00	2000-39
Q252	151-0256-00			TRANSISTOR:SILICON,NPN	80009	151-0256-00	2000-40
Q262	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00	
Q264	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00	
Q278	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00	2000-41
Q620	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00	
Q626	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00	
Q630	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q650	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00	
Q658	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00	
Q660	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00	
Q668	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00	
Q670	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00	
Q678	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00	
Q680	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00	
Q688	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00	
Q701	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q702	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00	2000-41
Q703	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q704	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00	2000-41

[1]Domestic
[2]Export

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TABLE 5-2. 640 MAINFRAME (Continued)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number	WILTRON Part No.
Q711	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q712	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00	2000-41
Q713	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q714	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00	2000-41
Q721	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00	
Q722	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00	
Q815	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	80009	151-0331-00	
Q815	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00	2000-42
Q820	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q825	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q840	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	80009	151-0331-00	
Q840	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00	2000-42
Q845	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q850	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00	
Q860	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	80009	151-0331-00	
Q860	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00	2000-42
Q865	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q870	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00	
Q875	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A	
Q885	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
Q890	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065	
R101	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015	
R102	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701	
R102	316-0221-00	B030000		RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211	
R103	316-0390-00	XB030000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901	
R104	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	91637	NS5B-B750R0F	
R106	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210R0F	
R108	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D	
R112	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701	
R112	316-0221-00	B030000		RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211	
R113	316-0390-00	XB030000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901	
R114	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	91637	MS5B-B750R0F	
R115	316-0470-00	XB030000	B049999X	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701	
R116	311-1132-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.5W	73138	91D-B100	
R118	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D	
R122	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701	
R122	316-0221-00	B030000		RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211	
R123	316-0390-00	XB030000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901	
R124	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	91637	NS5B-B750R0F	
R125	303-0751-00			RES.,FXD,CMPSN:750 OHM,5%,1W	01121	GB7515	
R126	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210R0F	
R128	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D	
R132	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701	
R132	316-0221-00	B030000		RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211	
R133	316-0390-00	XB030000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901	
R134	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	91637	NS5B-B750R0F	
R135	316-0470-00	XB030000	B049999X	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701	
R135	316-0390-00	XB080000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901	
R136	311-1132-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.5W	73138	91D-B100	
R138	308-0539-00			RES ,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D	
R140	316-0225-00	XB050000		RES.,FXD,CMPSN:2.2M OHM,10%,0.25W	01121	CB2251	
R200	311-1160-00			RES.,VAR,NONWIR:100K OHM,20%,1W	80009	311-1160-00	2000-88
R202	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635	
R203	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R206	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825	
R207	316-0822-00			RES.,FXD,CMPSN:8.2K OHM,10%,0.25W	01121	CB8221	
R208	316-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731	
R209	316-0224-00	XB050000		RES.,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241	
R211	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R213	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235	

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TABLE 5-2. 640 MAINFRAME (Continued)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number	WILTRON Part No.
R215	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R216	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535	
R217	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R218	316-0183-00			RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831	
R219	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835	
R222	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021	
R223	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721	
R226	316-0101-00	XB050000		RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011	
R227	321-0399-00			RES.,FXD,FILM:140K OHM,1%,0.125W	91637	MFF1816G14002F	
R231	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721	
R232	316-0274-00			RES.,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741	
R234	304-0223-00			RES.,FXD,CMPSN:22K OHM,10%,1W	01121	GB2231	
R236	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015	
R239	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015	
R242	316-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231	
R243	316-0105-00			RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051	
R245	311-1135-00	B010100	B029999	RES.,VAR,NONWIR:TRMR,1 MEG OHM 0.25W	71450	201-YA5535	
R245	311-1205-00	B030000		RES.,VAR,NONWIR:TRMR,2 MEG OHM,0.25W	71450	201-YA5545	
R248	316-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231	
R251	307-0058-00			RES.,FXD,CMPSN:5.6 OHM,5%,0.5W	01121	EB56G5	
R252	308-0075-00			RES.,FXD,WW:100 OHM,5%,3W	91637	RS2B-B100ROJ	
R254	308-0690-00			RES.,FXD,WW:3 OHM,10%,3W	91637	RS2B-DER000K	
R257	306-0104-00			RES.,FXD,CMPSN:100K OHM,10%,2W	01121	HB1041	
R262	302-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721	
P263	316-0183-00			RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831	
R266	316-0334-00			RES.,FXD,CMPSN:330K OHM,10%,0.25W	01121	CB3341	
R267	316-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331	
R268	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R269	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015	
R270	316-0223-00	XB060000		RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231	
R271	316-0395-00			RES.,FXD,CMPSN:3.9M OHM,10%,0.25W	01121	CB3951	
R272A R272B R272C R272D R272E	307-0296-00			RES.,FXD,FILM:	80009	307-0296-00	
R273	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045	
R274	316-0105-00			RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051	
R275	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536	
R276	316-0105-00			RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051	
R278	316-0562-00			RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621	
R279	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045	
R282	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635	
R285	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536	
R286	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536	
R287	301-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.50W	01121	EB1835	
R291	311-1189-00			RES.,VAR,WW:PNL,5K OHM,2W	10582	AW3349	
R295	311-0254-00			RES.,VAR,NONWIR:5M OHM,10%,1W	12697	381-CM29709	
R620	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021	
R621	316-0222-00			RES.,FXD,CMPSN:2.2K OHM,10%,0.25W	01121	CB2221	
R622	315-0223-00	B010100	B029999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235	
R622	315-0163-00	B030000		RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635	
R626	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021	
R628	315-0223-00	B010100	B029999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235	
R628	315-0183-00	B030000		RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835	
R630	316-0474-00			RES.,FXD,CMPSN:470K OHM,10%,0.25W	01121	CB4741	
R631	316-0332-00			RES.,FXD,CMPSN:3.3K OHM,10%,0.25W	01121	CB3321	
R632	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735	
R634	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R635	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021	

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TABLE 5-2. 640 MAINFRAME (Continued)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number	WILTRON Part No.
R636	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R637	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021	
R640	316-0562-00			RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621	
R641	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611	
R642	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R643	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021	
R650	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935	
R652	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735	
R656	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F	
R657	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225	
R659	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011	
R660	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935	
R662	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735	
R665	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F	
R666	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F	
R667	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225	
R670	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935	
R671	316-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311	
R672	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235	
R675	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534	
R676	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F	
R677	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225	
R679	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011	
R680	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935	
R681	316-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311	
R682	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235	
R685	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F	
R686	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F	
R687	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225	
R701	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R702	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R703	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R704	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R706	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R707	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R709	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R710	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031	
R712	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721	
R713	316-0332-00			RES.,FXD,CMPSN:3.3K OHM,10%,0.25W	01121	CB3321	
R715	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	91637	MFF1816G15002F	
R716	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F	
R717	321-0350-00			RES.,FXD,FILM:43.2K OHM,1%,0.125W	91637	MFF1816G43201F	
R718	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531	
R720	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F	
R721	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F	
R722	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F	
R723	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531	
R724	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721	
R810	302-0150-00			RES.,FXD,CMPSN:15 OHM,10%,0.50W	01121	EB1501	
R812	304-0683-00			RES.,FXD,CMPSN:68K OHM,10%,1W	01121	GB6831	
R815	308-0685-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500J	
R816	321-0215-00			RES.,FXD,FILM:1.69K OHM,1%,0.125W	91637	MFF1816G16900F	
R818	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F	
R820	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735	
R822	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811	
R824	316-0822-00			RES.,FXD,CMPSN:8.2K OHM,10%,0.25W	01121	CB8221	
R826	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015	
R827	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425	
R830	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045	
R832	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735	
R834	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835	

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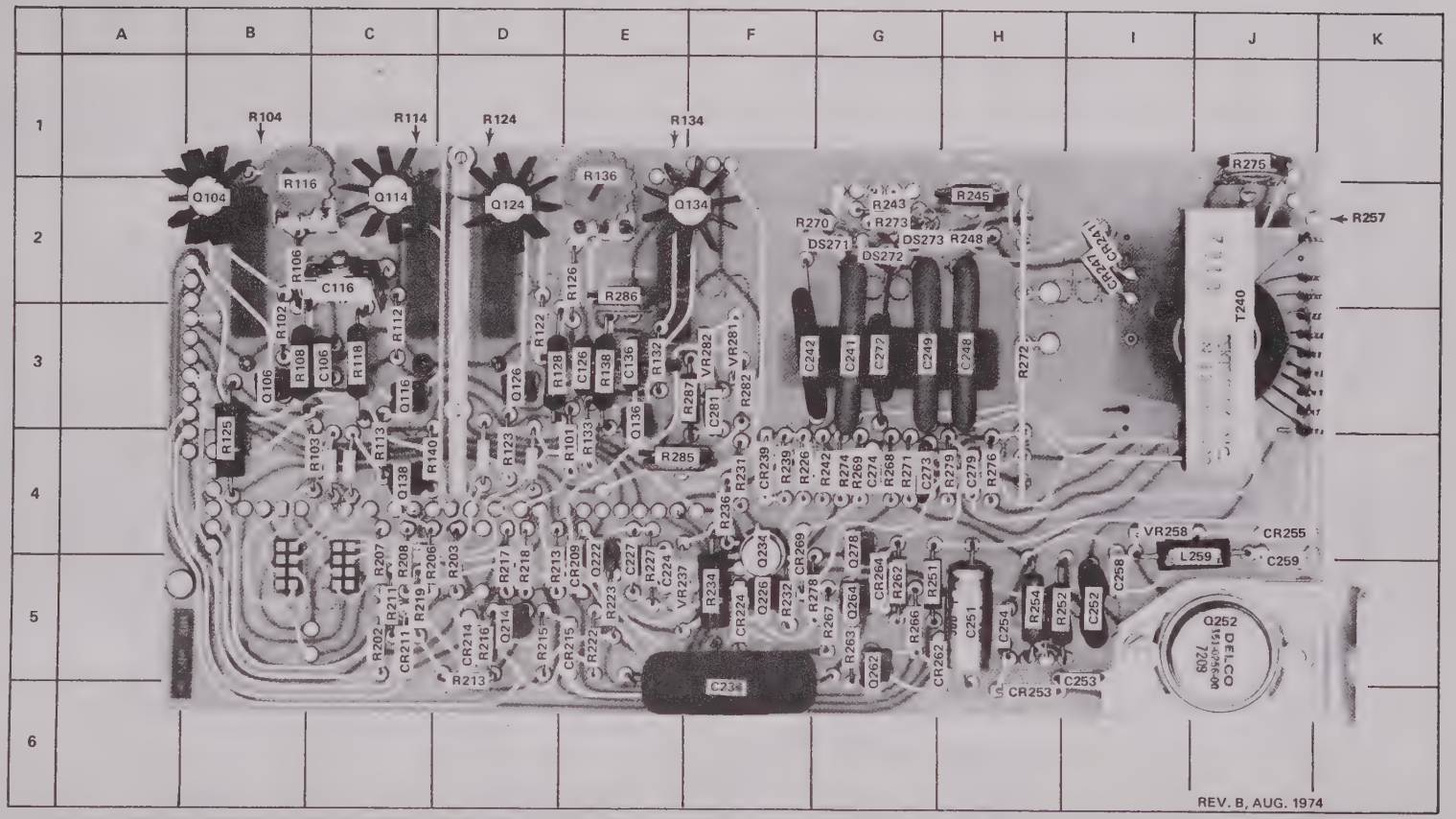
Name & Description	Mfr Code	Mfr Part Number	WILTRON Part No.
RES.,FXD,FILM:150 OHM,5%,10W	76055	7M0LNF150B	
RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J	
RES.,FXD.CMPSN:390 OHM,10%,0.25W	01121	CB3911	
RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835	
RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231	
RES.,FXD,CMPSN:33K OHM,10%,0.50W	01121	EB3331	
RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811	
RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035	
RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F	
RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5531	
RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F	
RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J	
RES.,FXD,FILM:120 OHM.5%,10W	76055	7M0LNF150B	
RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731	
RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315	
RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015	
RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215	
RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015	
RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925	
RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625	
RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211	
RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021	
RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015	
RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F	
RES.,FXD,NONWIR:250 OHM,30%,0.25W	71450	201-YA5533	
RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816G12400F	
RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721	
RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625	
RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021	
RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531	
RES.,FXD,FILM:7.23K OHM,0.25W,0.25W	91637	MFF1421D72300C	
RES.,FXD,FILM:100 OHM,0.25%,0.125W	91637	MFF1816D100R0C	
SWITCH,PUSH:0.5A AT 115VAC	81073	39YY2084	2000-18
SW,THERMOSTATIC:NC,OPEN 73.9,CL 51.7,10A	93410	110087	
SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301	2000-28
XFMR,PWR,STU:	80009	120-0705-01	
XFMR,PWR,STU:HV	80009	120-0761-00	
XFMR,PWR STPDN:	80009	120-0692-00	
XFMR,PWR SDN/SU:48-440HZ	80009	120-0704-00	
MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC	
ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0633-13	2000-51
ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0633-05	
ELECTRON TUBE:CRT,P7,INT SCALE	80009	154-0633-08	
ELECTRON TUBE:CRT,P11,INT SCALE	80009	154-0633-09	
SEMICOND DEVICE:ZENER,0.4W,43V,5%	04713	1N976B	
SEMICOND DEVICE:ZENER,3W,9.1V,5%	12969	UZ709	
SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	1N983B	
SEMICOND DEVICE:ZENER,0.4W,51V,5%	04713	1N978B	
SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	1N961B	
SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	1N983B	
SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B	
SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	81483	69-6585	

120-1230-00
TRANSFORMER

Main Frame

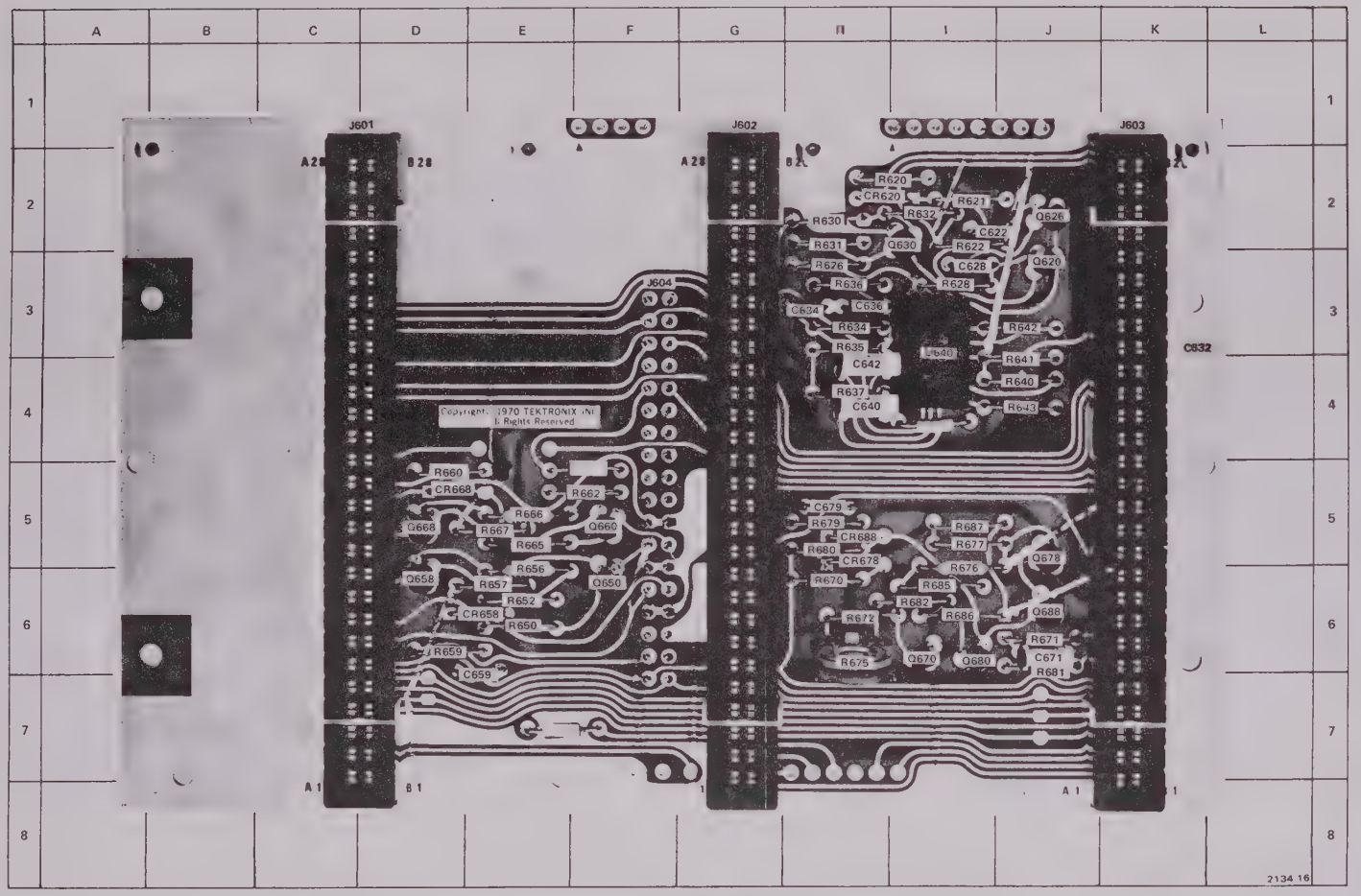
[1]Option 76 only
[2]Option 78 only

DEFLECTION AMPLIFIER/HIGH-VOLTAGE BOARD
PARTS LOCATION GRID



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C106	C-3	C252	I-5	CR209	E-5	CR269	F-4	DS271	G-2	Q104	B-2	Q234	F-4	R101	E-4	R124	D-1	R206	E-5	R223	E-5	R251	G-5	R273	G-2
C116	C-2	C253	I-5	CR211	C-5			DS272	G-2	Q106	B-3	Q252	J-5	R102	B-3	R125	B-4	R207	C-5	R226	F-4	R252	H-5	R274	G-4
C126	E-3	C254	H-5	CR214	D-5			DS273	G-2	Q114	C-2	Q262	G-5	R103	C-4	R126	E-2	R208	C-5	R227	E-5	R254	H-5	R275	J-1
C136	E-3	C258	I-5	CR215	E-5					Q116	C-3	Q264	G-5	R104	B-1	R128	D-3	R209	D-5	R231	F-4	R257	J-2	R276	H-4
C224	E-5	C259	J-4	CR224	F-5					Q124	D-2	Q278	F-4	R106	B-2	R132	E-3	R211	C-5	R232	F-5	R262	G-5	R278	G-5
C227	E-5	C272	G-3	CR239	F-4					Q126	D-3			R108	B-3	R133	E-4	R213	D-5	R234	F-5	R263	G-5	R279	H-4
C236	F-5	C273	G-4	CR241	I-2					Q134	F-2			R112	C-3	R134	E-1	R215	D-5	R236	F-4	R266	G-5	R282	F-3
C241	G-3	C274	G-4	CR247	I-2	VR237	E-5	L259	J-4	Q136	E-3			R113	C-4	R136	E-2	R216	D-5	R239	F-4	R267	G-5	R285	E-4
C242	F-3	C279	H-4	CR253	H-6	VR258	I-4			Q138	C-4			R116	B-2	R138	E-3	R217	D-5	R242	G-4	R268	G-4	R286	E-2
C248	H-3	C281	F-4	CR255	J-4	VR281	F-3			Q214	D-5			R118	C-3	R140	C-4	R218	D-5	R243	G-2	R269	G-4	R287	E-3
C249	G-3			CR262	G-5	VR282	F-3			Q222	F-5			R122	D-2	R202	C-5	R219	C-5	R245	H-2	R270	G-2		
C251	H-5			CR264	G-5					Q226	F-5			R123	D-4	R203	D-5	R222	E-5	R248	H-2	R271	G-4		

Figure 5-1. 640 Mainframe Deflection Amplifier/High-Voltage Board, Parts Location



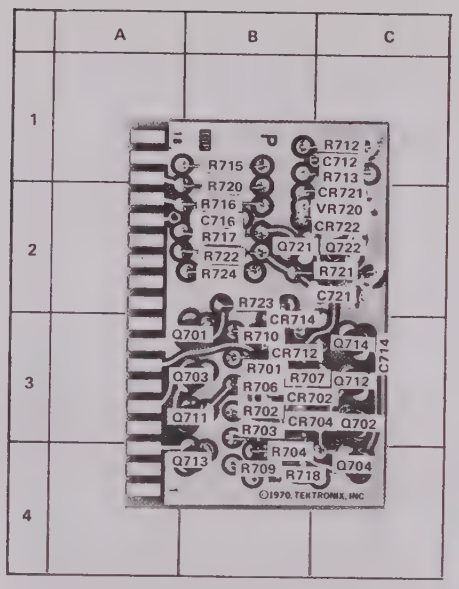
A3–Interface circuit board.

CKT NO	GRID LOC
C622	J-2
C628	I-3
C632†	K-3
C634	H-3
C636	H-3
C640	H-4
C642	H-4
C659	E-7
C671 *	J-6
C679	H-5
CR620	H-2
CR658	E-6
CR668	D-5
CR678	H-5
CR688	H-5
J601	C-1
J602	G-1
J603	K-1
J604†	F-3
Q620	J-3
Q626	J-2
Q630	I-2
Q650	F-6
Q658	D-6
Q660	F-5
Q668	D-5
Q670	I-6
Q678	J-5
Q680	I-6
Q688	J-6
R620	I-2
R621	I-2
R622	I-2
R626	H-3
R628	I-3
R630	H-2
R631	H-2
R632	I-2
R634	H-3
R635	H-3
R636	H-3
R637	H-4
R640	J-4
R641	J-4
R642	J-3
R643	J-4
R650	E-6
R651	F-5
R652	E-6
R656	E-6
R657	E-6
R658	D-6
R660	D-5
R662	F-5
R665	E-5
R666	E-5
R667	E-5
R669	E-7
R670	H-6
R671	J-6
R672	H-6
R675	H-6
R676	I-6
R677	I-5
R679	H-5
R680	H-5
R681	J-7
R682	I-6
R685	I-6
R686	I-6
R687	I-5
U640	I-3

*See Parts List for serial number ranges.

†Located on back of board.

Figure 5-2. 640 Mainframe Interface Circuit Board, Parts Location



CKT NO	GRID LOC	CKT NO	GRID LOC
C712	C-1	Q721	B-2
C714	C-3	Q722	C-2
C716	B-2		
C721	C-2	R701	B-3
		R702	B-3
CR702	C-3	R703	B-3
CR704	C-3	R704	B-4
CR712	B-3	R706	B-3
CR714	B-3	R707	B-3
CR721	C-2	R709	B-4
CR722	C-2	R710	B-3
		R712	C-1
VR720	C-2	R713	C-1
		R715	B-1
Q701	B-3	R716	B-2
Q702	C-3	R717	B-2
Q703	B-3	R718	B-4
Q704	C-4	R720	B-2
Q711	B-3	R721	C-2
Q712	C-3	R722	B-2
Q713	B-4	R723	B-2
Q714	C-3	R724	B-2

Figure 5-3. 640 Mainframe Auxiliary Board, Parts Location

Voltage Drop Assembly 640-S-5301

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	.01μF, 100V, C	230-11
Q1	2N3694	20-2N3694
R1	68, 5W, 5%, WW	130-68-5
R2	68, 5W, 5%, WW	130-68-5
R3	1.5k, 1W, 10%, CC	101-1.5k-10
R4	10k, 1/4W, 5%, CC	101-10k-5
R5	2.7, 1/8W, 5%, CC	100-2.7-5

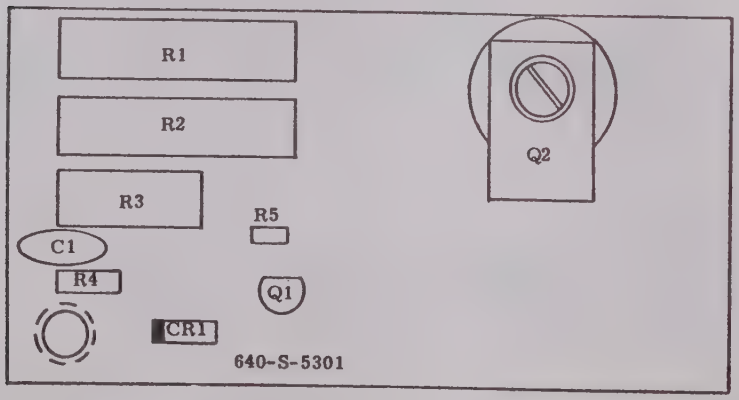


Figure 5-4. Mainframe Interface Board Voltage Drop PC Assembly, Parts Location

Δ - See Manual Title Page
5-640-OMM

Pen Lift Assembly (Option 2) 640-MS-4952

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR101	SI2	10-SI2
K101	Relay, 5V	690-11
Q101	2N3565	20-2N3565
Q102	2N3565	20-2N3565
R101	5.11k, 1/4W, 1%, MF	110-5.11k-1
R102	5.11k, 1/4W, 1%, MF	110-5.11k-1
R103	5.11k, 1/4W, 1%, MF	110-5.11k-1
R104	5.11k, 1/4W, 1%, MF	110-5.11k-1

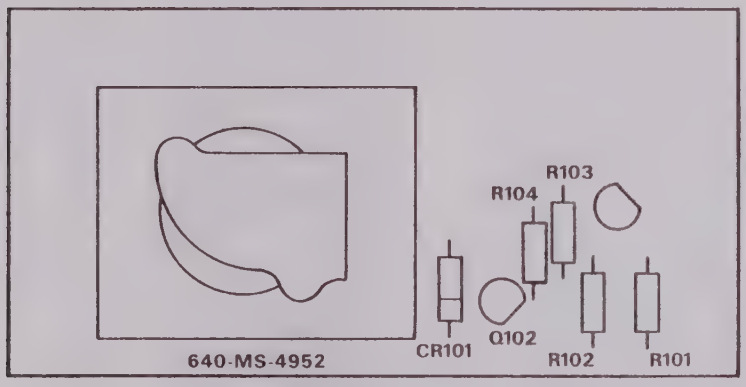


Figure 5-5. Pen Lift PC Assembly (Option 2), Parts Location

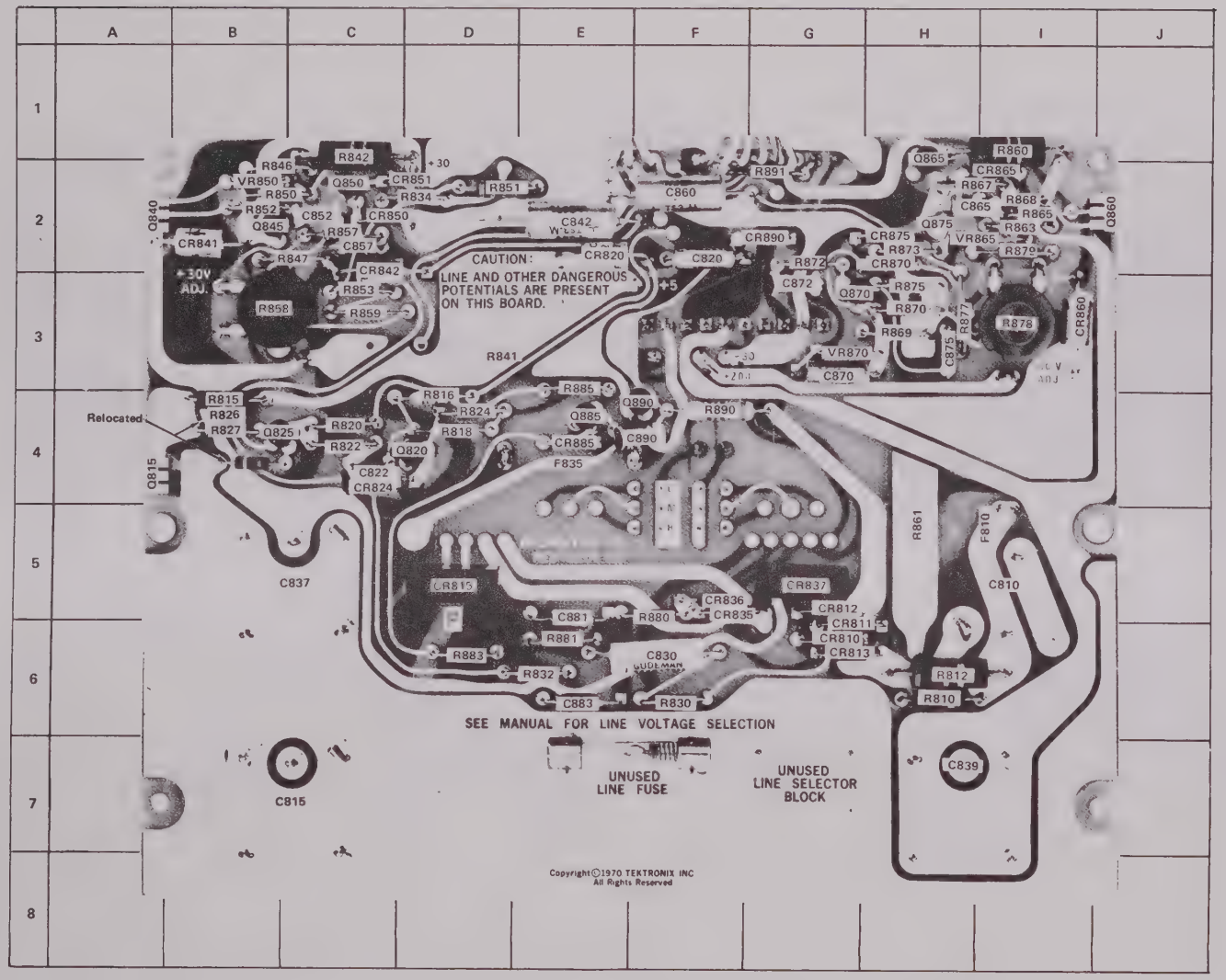
640 Mainframe Hardware

REF. DES.	DESCRIPTION	WILTRON PART NO.
----	ON Lamp	632-29
----	ON Lens Cap	632-31
----	TILT Knob	640-S-5231
----	FOCUS Knob	640-S-6673
----	AMPL Knob	710-55

Miscellaneous

REF. DES.	DESCRIPTION	WILTRON PART NO.
----	Front and Rear Protective Covers, Option 4	640-MS-4951-1
----	Fiberglass Carrying Case	2000-21
----	Rack Mount Conversion Kit	2000-20

5103N POWER SUPPLY BOARD PARTS LOCATION GRID



CKT NO	GRID LOC	CKT NO	GRID LOC
C810	I-5	Q875	H-2
C815	C-5	Q885	E-4
C820	F-2	Q890	F-4
C822	C-4		
C830	F-6		
C837	C-7		
C839	H-7	R810	H-6
C842	E-2	R812	H-6
C852	C-2	R815	B-4
C857	C-2	R816	D-4
C860	F-2	R818	D-4
C865	H-2	R820	C-4
C870	G-3	R822	C-4
C872	G-3	R824	D-4
C875	H-3	R826	B-4
C881	E-5	R827	B-4
C883	E-6	R830	F-6
C890	F-4	R832	E-6
		R834	D-2
		R841	D-3
		R842	C-1
CR810	G-6	R846	B-2
CR811	G-6	R847	C-2
CR812	G-5	R850	B-2
CR813	G-6	R851	D-2
CR815	G-5	R852	B-2
CR820	E-2	R853	C-3
CR824	C-4	R857	C-2
CR835	F-5	R858	B-3
CR836	F-5	R859	C-3
CR837	D-5	R860	I-1
CR841	B-2	R861	H-5
CR842	C-2	R863	I-2
CR850	C-2	R865	I-2
CR851	D-2	R867	H-2
CR860	I-3	R868	I-2
CR865	I-2	R869	H-3
CR870	H-2	R870	H-3
CR875	H-2	R872	G-2
CR885	E-4	R873	H-2
CR890	G-2	R875	H-3
		R877	H-3
		R878	I-3
		R879	I-2
VR850	B-2	R880	F-5
VR865	I-2	R881	E-6
VR870	G-3	R883	D-6
		R885	E-3
		R890	F-4
		R891	G-2
F810	I-5		
F835	E-4		
Q815	A-4		
Q820	D-4		
Q825	B-4		
Q840	A-2		
Q845	B-2		
Q850	C-2		
Q860	J-2		
Q865	H-1		
Q870	G-3		

Figure 5-6. 640 Mainframe Power Supply Board, Parts Location

TABLE 5-3. 640G SWEEP GENERATOR

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1A	10k variable (CENTER FREQUENCY)	149-10k
R1B	10k variable (CENTER FREQUENCY)	152-10k-1
R1C	2.32k 1/4W 1% MF (CENTER FREQUENCY)	110-2.32k-1
R2	2.5k variable (WIDTH VERNIER)	155-2.5k
R3	2.5k 2W 10% variable (SWEEP RATE)	143-2.5kA
R4	10k 1/2W 10% variable (MARKER WIDTH)	152-10kB
R5	5.90k 1/4W 1% MF (SWEEP WIDTH)	110-5.90k-1
R6	37.4k 1/4W 1% MF (SWEEP WIDTH)	110-37.4k-1
R7	196k 1/4W 1% MF (SWEEP WIDTH)	110-196k-1
R9	SLOPE control, 1k, 1/2W	152-1kB
R10	RF POWER VERNIER control, 10k, 1/2W	152-10kA or 152-10kC

640G Sweep Generator Hardware

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	SWEEP WIDTH Knob	430-55A
---	MARKER SPACING Knob	430-55A
---	RF OUT dBm Knob	640-S-4618
---	CENTER FREQUENCY, MHz Knob	640-S-5881
---	SWEEP RATE Knob	710-45
---	RF OUT dBm Vernier Knoo	710-48
---	CENTER FREQUENCY, MHz Vernier Knob	710-48
---	WIDTH VERNIER Knob	710-54
---	MKR WIDTH Knob	61084-S-5452

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Sweep Generator PC Assy (Table 5-4)	640-L-4626-3
---	RF Section, 50Ω	640-ML-5145-50
---	RF Section, 75Ω	640-ML-5145-75
---	Marker Section	640-ML-5225
---	Attenuator: Power Level Assy, 50Ω	640-MS-4627-1
---	10 dB Step Attenuator, 50Ω	1010-23
---	Attenuator: Power Level Assy, 75Ω	640-MS-4627-2
---	10 dB Step Attenuator, 75Ω	1010-24
---	Cable Assy: SMA-BNC 50Ω	640-MS-5303-1
---	Cable Assy: SMA-BNC 75Ω	640-MS-5304-1
---	Cable Assy: BNC-M-M 50Ω UT141	640-MS-5751
---	Cable Assy: BNCM to NM 50Ω UT141	640-MS-5752
---	Cable Assy: BNC-M-M 75Ω UT141	640-MS-5753
---	Cable Assy: BNCM to NM 75Ω UT141	640-MS-5754
---	Latch Assembly	2000-93
---	Side Covers	2000-6

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S1	Slide; 1 pole 6 position (SWEEP WIDTH)	430-55
S2	Slide; 1 pole 6 position (MARKER SPACING)	430-55
S3	Slide; 2 pole 3 position (SWEEP RATE)	430-53
S4	Slide; 3 pole 3 position (TRIGGER)	430-56
S5	Push; momentary contact (SINGLE SWEEP)	430-57

TABLE 5-4. 640G SWEEP GENERATOR PC ASSEMBLY 640-L-4626

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	.01μF, 100V, C	230-11
C2	.01μF, 100V, C	230-11
C3	27pF, 100V, M	223-27
C4	27pF, 100V, M	223-27
C5	4.7μF, 35V, T	250-39A
C6	4.7μF, 35V, T	250-39A
C7	4.7μF, 35V, T	250-39A
C8	.1μF, 250V, My	210-30
C9	.002μF, 500V, C	230-33
C11	4.7μF, 35V, T	250-39A
C12	4.7μF, 35V, T	250-39A
C13	.033μF, 50V, C	230-32
C14	--not used--	
C15	.01μF, 100V, C	230-11
C16	2.2μF, 20V, T	250-40
C17	100μF, ±10, 20V, E	250-76
C18	4.7μF, 35V, T	250-39A
C19	.1μF, 10V, C	230-12
C20	4.7μF, 35V, T	250-39A
C21	4.7μF, 35V, T	250-39A
C22	4.7μF, 35V, T	250-39A
C23	.001μF, 1KV, C	230-3
C24	.01μF, 100V, C	230-11
C25	4.7μF, 35V, T	250-39A
C26	27pF, 100V, M	223-27
C27	4.7μF, 35V, T	250-39A
C28	4.7μF, 35V, T	250-39A
C29	27pF, 100V, M	223-27
C30	27pF, 100V, M	223-27
C31	4.7μF, 35V, T	250-39A
C32	47μF, 63V, E	250-51
C33	47μF, 63V, E	250-51
C34	.1μF, 10V, C	230-12
C35	.1μF, 10V, C	230-12
C36	4.7μF, 35V, T	250-39A

C = Ceramic
E = Electrolytic
My = Mylar
T = Tantalum
M = Mica

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	1N751A	10-1N751A
CR2	1N823	10-1N823
CR3	SI-2	10-SI-2
CR5	1N4446	10-1N4446
CR6	1N4446	10-1N4446
CR7	1N4446	10-1N4446
CR8	1N4446	10-1N4446
CR9	1N4446	10-1N4446
CR10	1N4446	10-1N4446
CR11	1N4446	10-1N4446
CR12	1N4446	10-1N4446
CR13	1N4446	10-1N4446
CR14	1N4446	10-1N4446
CR15	1N4446	10-1N4446
CR16	1N4446	10-1N4446
CR17	1N4446	10-1N4446
CR18	1N759A	10-1N759A
CR19	1N4446	10-1N4446
CR20	1N4446	10-1N4446
CR21	1N4446	10-1N4446
CR22	1N4446	10-1N4446
CR23	1N4446	10-1N4446
CR24	1N4446	10-1N4446
CR25	1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	2N2222A	20-2N2222A
Q2	2N4249	20-2N4249
Q3	2N3694	20-2N3694
Q4	2N3694	20-2N3694
Q5	2N3694	20-2N3694
Q6	2N3694	20-2N3694
Q7	2N4249	20-2N4249
Q8	2N4249	20-2N4249
Q9	2N4249	20-2N4249
Q10	2N3694	20-2N3694
Q11	2N4249	20-2N4249
Q12	2N3694	20-2N3694
Q13	2N4249	20-2N4249
Q14	2N3694	20-2N3694
Q15	2N3694	20-2N3694
Q16	2N3694	20-2N3694
Q17	2N4249	20-2N4249

Q18	2N4249	20-2N4249
Q19	2N5192	20-2N5192
Q20	2N5195	20-2N5195
Q21	2N6428	20-2N6428
Q22	2N6428	20-2N6428
Q23	2N6428	20-2N6428
Q24	2N6428	20-2N6428

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	2.7Ω, 1/8W, 5% CC	100-2.7-5
R2	14.7k, 1/4W, 1% MF	110-14.7k-1
R3	5.62k, 1/4W, 1% MF	110-5.62k-1
R4	5.62k, 1/4W, 1% MF	110-5.62k-1
R5	3.48k, 1/4W, 1% MF	110-3.48k-1
R6	1k variable	156-1KA
R7	3.48k, 1/4W, 1% MF	110-3.48k-1
R8	8.25k, 1/4W, 1% MF	110-8.25k-1
R9	2.7Ω, 1/8W, 5% CC	100-2.7-5
R10	14.7k, 1/4W, 1% MF	110-14.7k-1
R11	2.87k, 1/4W, 1% MF	110-2.87k-1
R12	187Ω, 1/4W, 1% MF	110-187-1
R13	1.96k, 1/4W, 1% MF	110-1.96k-1
R14	5.11k, 1/4W, 1% MF	110-5.11k-1
R15	19.6k, 1/4W, 1% MF	110-19.6k-1
R16	5.11k, 1/4W, 1% MF	110-5.11k-1
R17	19.6k, 1/4W, 1% MF	110-19.6k-1
R18	19.6k, 1/4W, 1% MF	110-19.6k-1
R19	10k, 1/4W, 1% MF	110-10k-1
R20	2.87k, 1/4W, 1% MF	110-2.87k-1
R21	274k, 1/4W, 1% MF	110-274k-1
R22	10k, 1/4W, 1% MF	110-10k-1
R23	5k, variable	156-5kA
R24	247k, 1/4W, 1% MF	110-247k-1
R25	38.3k, 1/4W, 1% MF	110-38.3k-1
R26	1k variable	156-1KA
R27	19.6k, 1% MF	110-19.6k-1
R28	511k, 1/4W, 1% MF	110-511k-1
R29	5.11k, 1/4W, 1% MF	110-5.11k-1
R30	5.11k, 1/4W, 1% MF	110-5.11k-1
R31	19.6k, 1/4W, 1% MF	110-19.6k-1
R32	38.3k, 1/4W, 1% MF	110-38.3k-1
R33	1M, 1/4W, 1% MF	110-1M-1
R34	1M, 1/4W, 1% MF	110-1M-1
R35	38.3k, 1/4W, 1% MF	110-38.3k-1
R36	19.6k, 1/4W, 1% MF	110-19.6k-1
R37	19.6k, 1/4W, 1% MF	110-19.6k-1
R38	38.3k, 1/4W, 1% MF	110-38.3k-1
R39	38.3k, 1/4W, 1% MF	110-38.3k-1
R40	3.32k, 1/4W, 1% MF	110-3.32k-1
R41	10k, 1/4W, 1% MF	110-10K-1
R42	1k, variable	156-1KA
R43	10k, 1/4W, 1% MF	110-10k-1
R44	10k, 1/4W, 1% MF	110-10k-1
R45	10k, 1/4W, 1% MF	110-10k-1
R46	19.6k, 1/4W, 1% MF	110-19.6k-1
R47	11k, 1/4W, 1% MF	110-11k-1
R48	5.11k, 1/4W, 1% MF	110-5.11k-1
R49	1M, 1/4W, 1% MF	110-1M-1A
R50	619, 1/4W, 1%, MF	110-619-1
R51	9.09k, 1/4W, 1% MF	110-9.09k-1
R52	12.1k, 1/4W, 1% MF	110-12.1k-1
R53	4.22k, 1/4W, 1% MF	110-4.22k-1
R54	13.3k, 1/4W, 1% MF	110-13.3k-1
R55	13.3k, 1/4W, 1% MF	110-13.3k-1
R56	51.1k, 1/4W, 1% MF	110-51.1k-1
R57	5.11k, 1/4W, 1% MF	110-5.11k-1
R58	1M, 1/4W, 1% MF	110-1M-1A
R59	10k variable	156-10KA
R60	24.3k, 1/4W, 1% MF	110-24.3k-1
R61	2.37k, 1/4W, 1% MF	110-2.37k-1
R62	2.37k, 1/4W, 1% MF	110-2.37k-1
R63	19.6k, 1/4W, 1% MF	110-19.6k-1
R64	19.6k, 1/4W, 1% MF	110-19.6k-1
R65	19.6k, 1/4W, 1% MF	110-19.6k-1
R66	19.6k, 1/4W, 1% MF	110-19.6k-1
R67	10k, 1/4W, 1% MF	110-10k-1
R68	10k, 1/4W, 1% MF	110-10k-1
R69	196k, 1/4W, 1% MF	110-196k-1
R70	10k, 1/4W, 1% MF	110-10k-1
R71	19.6k, 1/4W, 1% MF	110-19.6k-1
R72	10k, 1/4W, 1% MF	110-10k-1
R73	31.6k, 1/4W, 1% MF	110-31.6k-1
R74	10k, 1/4W, 1% MF	110-10k-1
R75	10k, 1/4W, 1% MF	110-10k-1
R76	10k, 1/4W, 1% MF	110-10k-1
R77	3.83k, 1/4W, 1% MF	110-3.83k-1
R78	14.7k, 1/4W, 1% MF	110-14.7k-1
R79	19.6k, 1/4W, 1% MF	110-19.6k-1
R80	19.6k, 1/4W, 1% MF	110-19.6k-1
R81	5.62k, 1/4W, 1% MF	110-5.62k-1
R82	19.6k, 1/4W, 1% MF	110-19.6k-1
R83	14.7k, 1/4W, 1% MF	110-14.7k-1
R84	5.62k, 1/4W, 1% MF	110-5.62k-1
R85	19.6k, 1/4W, 1% MF	110-19.6k-1
R86	5.11k, 1/4W, 1% MF	110-5.11k-1
R87	1k, 1/4W, 1% MF	110-1k-1
R88	16.2k, 1/4W, 1% MF	110-16.2k-1
R89	5k variable	156-5KA
R90	1k, 1/4W, 1% MF	110-1k-1
R91	1k, 1/4W, 1% MF	110-1k-1
R92	10k variable	156-10KA
R93	56.2k, 1/4W, 1% MF	110-56.2k-1
R94	28.7k, 1/4W, 1% MF	110-28.7k-1

TABLE 5-4. 640G SWEEP GENERATOR PC ASSY 640-L-4626 (Continued)

R95	82.5k, 1/4W, 1% MF	110-82.5k-1
R96	10k variable	156-10KA
R97	10k, 1/4W, 1% MF	110-10k-1
R98	17.8k, 1/4W, 1% MF	110-17.8k-1
R99	10k variable	156-10KA
R100	19.6k, 1/4W, 1% MF	110-19.6k-1
R101	19.6k, 1/4W, 1% MF	110-19.6k-1
R102	19.6k, 1/4W, 1% MF	110-19.6k-1
R103	6.81k, 1/4W, 1% MF	110-6.81k-1
R104	20k variable	156-20KA
R105	100k, 1/4W, 1% MF	110-100k-1
R106	100k, 1/4W, 1% MF	110-100k-1
R107	31.6k, 1/4W, 1% MF	110-31.6k-1
R108	10M, 1/4W, 5% CC	101-10M-5
R109	2.4M, 1/4W, 5% CC	101-2.4M-5
R110	1M variable	156-1MA
R111	20k variable	156-20KA
R112	100k, 1/4W, 1% MF	110-100k-1
R113	10k, 1/4W, 1% MF	110-10k-1
R114	5.11k, 1/4W, 1% MF	110-5.11k-1
R115	10k, 1/4W, 1% MF	110-10k-1
R116	100k, 1/4W, 1% MF	110-100k-1
R117	1.96k, 1/4W, 1% MF	110-1.96k-1
R118	619Ω, 1/4W, 1% MF	110-619-1
R119	6.81k, 1/4W, 1% MF	110-6.81k-1
R120	6.81k, 1/4W, 1% MF	110-6.81k-1
R121	1M, 1/4W, 1% MF	110-1M-1A
R122	1M, 1/4W, 1% MF	110-1M-1A
R123	5.11k, 1/4W, 1% MF	110-5.11k-1
R124	14.7k, 1/4W, 1% MF	110-14.7k-1
R125	38.3k, 1/4W, 1% MF	110-38.3k-1
R126	38.3k, 1/4W, 1% MF	110-38.3k-1
R127	9.09k, 1/4W, 1% MF	110-9.09k-1
R128	14.7k, 1/4W, 1% MF	110-14.7k-1
R129	1.96k, 1/4W, 1% MF	110-1.96k-1
R130	5k variable	156-5KA
R131	9.09k, 1/4W, 1% MF	110-9.09k-1
R132	5.11k, 1/4W, 1% MF	110-5.11k-1
R133	5.11k, 1/4W, 1% MF	110-5.11k-1
R134	5.11k, 1/4W, 1% MF	110-5.11k-1
R135	50k variable	156-50KA
R136	10k, 1/4W, 1% MF	110-10k-1
R137	56.2k, 1/4W, 1% MF	110-56.2k-1
R138	51.5k, 1/4W, 1% MF	110-51.5k-1
R139	5.11k, 1/4W, 1% MF	110-5.11k-1
R140	50k variable	156-50KA
R141	10k, 1/4W, 1% MF	110-10k-1
R142	60.4k, 1/4W, 1% MF	110-60.4k-1
R143	51.1k, 1.4W, 1% MF	110-51.1k-1
R144	5.11k, 1/4W, 1% MF	110-5.11k-1
R145	5.11k, 1/4W, 1% MF	110-5.11k-1
R146	50k variable	156-50KA
R147	10k, 1.4W, 1% MF	110-10k-1
R148	51.1k, 1/4W, 1% MF	110-51.1k-1
R149	68.1k, 1/4W, 1% MF	110-68.1k-1
R150	10k, 1/4W, 1% MF	110-10k-1
R151	5.11k, 1/4W, 1% MF	110-5.11k-1
R152	50k variable	156-50KA
R153	2.15k, 1/4W, 1% MF	110-2.15k-1
R154	56.2k, 1/4W, 1% MF	110-56.2k-1
R155	12.1k, 1/4W, 1% MF	110-12.1k-1
R156	2.15k, 1/4W, 1% MF	110-2.15k-1
R157	5k variable	156-5KA
R158	6.19k, 1/4W, 1% MF	110-6.19k-1
R159	11k, 1/4W, 1% MF	110-11k-1
R160	19.6k, 1/4W, 1% MF	110-19.6k-1
R161	14.7k, 1/4W, 1% MF	110-14.7k-1
R162	20k variable	156-20KA
R163	10k, 1/4W, 1% MF	110-10k-1
R164	1k, 1/4W, 1% MF	110-1k-1
R165	5.11k, 1/4W, 1% MF	110-5.11k-1
R166	5.11k, 1/4W, 1% MF	110-5.11k-1
R167	5k variable	156-5KA
R168	7.32k, 1/4W, 1% MF	110-7.32k-1
R169	4.64k, 1/4W, 1% MF	110-4.64k-1
R170	14.7k, 1/4W, 1% MF	110-14.7k-1
R171	9.09k, 1/4W, 1% MF	110-9.09k-1
R172	5k variable	156-5KA
R173	1k, 1/4W, 1% MF	110-1k-1
R174	1.96k, 1/4W, 1% MF	110-1.96k-1
R175	19.6k, 1/4W, 1% MF	110-19.6k-1
R176	--not used--	---
R177	--not used--	---
R178	19.6k, 1/4W, 1% MF	110-19.6k-1
R179	19.6k, 1/4W, 1% MF	110-19.6k-1
R180	19.6k, 1/4W, 1% MF	110-19.6k-1
R181	10k, 1/4W, 1% MF	110-10k-1
R182	10k, 1/4W, 1% MF	110-10k-1
R183	19.6k, 1/4W, 1% MF	110-19.6k-1
R184	1k, 1/4W, 1% MF	110-1k-1
R185	499, 1/4W, 1% MF	110-499-1
R186	6.81k, 1/4W, 1% MF	110-6.81k-1
R187	5.11k, 1/4W, 1% MF	110-5.11k-1
R188	10k, 1/4W, 1% MF	110-10k-1
R189	19.6k, 1/4W, 1% MF	110-19.6k-1
R190	10k, 1/4W, 1% MF	110-10k-1
R191	19.6k, 1/4W, 1% MF	110-19.6k-1
R192	100k, 1/4W, 1% MF	110-100k-1
R193	51.1k, 1/4W, 1% MF	110-51.1k-1
R194	10k, 1/4W, 1% MF	110-10k-1
R195	19.6k, 1/4W, 1% MF	110-19.6k-1
R196	19.6k, 1/4W, 1% MF	110-19.6k-1
R197	19.6k, 1/4W, 1% MF	110-19.6k-1
R198	19.6k, 1/4W, 1% MF	110-19.6k-1

TABLE 5-4. 640G SWEEP GENERATOR PC ASSY 640-L-4626 (Continued)

R199	19.6k, 1/4W, 1% MF	110-19.6k-1
R200	19.6k, 1/4W, 1% MF	110-19.6k-1
R201	19.6k, 1/4W, 1% MF	110-19.6k-1
R202	19.6k, 1/4W, 1% MF	110-19.6k-1
R203	383Ω, 1/4W, 1% MF	110-383Ω-1

CC= Carbon Composition
MF= Metal Film

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	LM301A	50-LM301A
U2	LM301A	50-LM301A
U3	RC4136	54-RC4136
U6	LM301A	50-LM301A
U7	RC4136	54-RC4136
U8	--not installed--	
U9	DG200BA	50-DG200BA
U10	3302	54-3302
U11	7400	54-7400
U12	7410	54-7410
U13	7403	54-7403
U14	RC4136	54-RC4136
U15	RC4136	54-RC4136
U16	RC4136	54-RC4136
U17	7400	54-7400
U18	7472	54-7472
U19	7400	54-7400
U20	LM301A	50-LM301A
U21	LM301A	50-LM301A

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
K1	Relay, reed, DPST	690-3
S1	Switch, slide, DPDT	430-46

TABLE 5-5. MARKER RF PC ASSEMBLY 640-ML-4621

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	.001μF, 100V, C	230-30
C2	22pF, 100V, M	223-22
C3	2-18.5pF	240-12
C4	10pF, 100V, M	223-10
C5	.001μF, 100V, C	230-30
C6	100pF, 100V, M	223-100
C7	.02μF, 100V, C	230-20
C8	.001μF, 100V, C	230-30
C9	100pF, 100V, M	223-10
C10	15pF, 100V, M	223-15
C11	3pF, 50V, Chip	228-17
C12	1pF, 50V, Chip	228-12
C13	.01μF, 50V, Chip	228-10
C14	.01μF, 50V, Chip	228-10
C15	4.7μF, 35V, T	250-39A
C16	.02μF, 100V, C	230-20
C17	1.0μF, 35V, T	250-19A
C18	1.0μF, 35V, T	250-19A
C19	47μF, 100V, M	223-47
C20	3pF, 100V, M	223-3
C21	100pF, 100V, M	223-100
C22	18pF, 100V, M	223-18
C23	39pF, 100V, M	223-39
C24	.02μF, 100V, C	230-20
C25	.02μF, 100V, C	230-20
C26	*	
C27	4.7μF, 35V, T	250-39A
C28	-- not used --	---
C29	1.0μF, 35V, T	250-19A
C30	68μF, 6V, T	250-58A
C31	100pF, 100V, M	223-100
C32	1.0μF, 35V, T	250-19A
C33	.02μF, 100V, C	230-20
C34	1.0μF, 35V, T	250-19A
C35	1.0μF, 35V, T	250-19A
C36	*	---
C37	-- not used --	---
C38	.02μF, 100V, C	230-20
C39	100pF, 100V, M	223-100
C40	10pF, 100V, M	223-10

TABLE 5-5. MARKER PC ASSEMBLY 640-ML-4621
(Continued)

C41	-- not used --	---
C42	100pF, 100V, M	223-100
C43	4.7μF, 35V, T	250-39A
C44	10pF, 100V, M	223-10
C45	-- not used --	---
C46	100pF, 100V, M	223-100
C47	.02μF, 100V, C	230-20
C48	4.7μF, 35V, T	250-39A
C49	100pF, 100V, M	223-100

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Step Recovery Diode	10-5
CR2	Point Contact Diode	10-PD0831
CR3	Point Contact Diode	10-PD0831
CR4	1N751A	10-1N751A
CR5	Hot Carrier Diode	10-4
CR6	Hot Carrier Diode	10-4
CR7	Hot Carrier Diode	10-4

INDUCTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
L1	.33μH	310-36
L2	10μH	310-61
L3	.18μH	310-58
L4	.33μH	310-36
L5	.18μH	310-58
L6	.15μH	310-57
L7	100μH	310-60
L8	10μH	310-61
L9	10μH	310-61
L10	10μH	310-61
L11	10μH	310-61
L12	100μH	360-60
L13	100μH	360-60
L14	100μH	360-60

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	2N3563	20-2N3563
Q2	2N3563	20-2N3563
Q3	2N3563	20-2N3563
Q4	2N3563	20-2N3563
Q5	2N3563	20-2N3563
Q6	2N3563	20-2N3563
Q7	2N3563	20-2N3563
Q8	2N3563	20-2N3563
Q9	2N3563	20-2N3563
Q10	2N3563	20-2N3563
Q11	2N4249	20-2N4249
Q12	2N4249	20-2N4249
Q13	2N4249	20-2N4249

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	10k, 1/8W, 5%, MF	109-10k-5
R2	16k, 1/8W, 5%, MF	109-16k-5
R3	2k, 1/8W, 5%, MF	109-2k-5
R4	750, 1/8W, 5%, MF	109-750-5
R5	5.1k, 1/8W, 5%, MF	109-5.1k-5
R6	2k, 1/8W, 5%, MF	109-2k-5
R7	16k, 1/8W, 5%, MF	109-16k-5
R8	7.5k, 1/8W, 5%, MF	109-7.5k-5
R9	1.5k, 1/8W, 5%, MF	109-1.5k-5
R10	51, 1/8W, 5%, MF	109-51-5
R11	5.1k, 1/8W, 5%, MF	109-5.1k-5
R12	2k, 1/8W, 5%, MF	109-2k-5
R13	510, 1/8W, 5%, MF	109-510-5
R14	75k, 1/8W, 5%, MF	109-75k-5
R15	1.5k, 1/8W, 5%, MF	109-1.5k-5
R16	51, 1/8W, 5%, MF	109-51-5
R17	390, 1/8W, 5%, MF	109-390-5
R18	2k, 1/8W, 5%, MF	109-2k-5
R19	3k, 1/8W, 5%, MF	109-3k-5
R20	510, 1/8W, 5%, MF	109-510-5
R21	180, 1/8W, 5%, MF	109-180-5

TABLE 5-5. MARKER RF PC ASSEMBLY 640-ML-4621 (Continued)

R22	91, 1/8W, 5%, MF	109-91-5
R23	750, 1/8W, 5%, MF	109-750-5
R24	82, 1/8W, 5%, MF	109-82-5
R25	180, 1/8W, 5%, MF	109-180-5
R26	180, 1/8W, 5%, MF	109-180-5
R27	100, 1/8W, 5%, MF	109-100-5
R28	100, 1/8W, 5%, MF	109-100-5
R29	24, 1/8W, 5%, MF	109-24-5
R30	150, 1/8W, 5%, MF	109-150-5
R31	2k, 1/8W, 5%, MF	109-2k-5
R32	5.1k, 1/8W, 5%, MF	109-5.1k-5
R33	33, 1/8W, 5%, MF	109-33-5
R34	51, 1/8W, 5%, MF	109-51-5
R35	1k, 1/8W, 5%, MF	109-1k-5
R36	-- not used --	---
R37	330, 1/2W, 5%, CC	102-330-5
R38	-- not used --	---
R39	1k, 1/8W, 5%, MF	109-1k-5
R40	1k, 1/8W, 5%, MF	109-1k-5
R41	16, 1/8W, 5%, MF	109-16-5
R42	750, 1/8W, 5%, MF	109-750-5
R43	1k, 1/8W, 5%, MF	109-1k-5
R44	5.1k, 1/8W, 5%, MF	109-5.1k-5
R45	150, 1/8W, 5%, MF	109-150-5
R46	1k, 1/8W, 5%, MF	109-1k-5
R47	1.5k, 1/8W, 5%, MF	109-1.5k-5
R48	10k, 1/8W, 5%, MF	109-10k-5
R49	10k, 1/8W, 5%, MF	109-10k-5
R50	27k, 1/8W, 5%, MF	109-27k-5
R51	1.5k, 1/8W, 5%, MF	109-1.5k-5
R52	10k, 1/8W, 5%, MF	109-10k-5
R53	75k, 1/8W, 5%, MF	109-75k-5
R54	1.5k, 1/8W, 5%, MF	109-1.5k-5
R55	10k, 1/8W, 5%, MF	109-10k-5
R56	10k, 1/8W, 5%, MF	109-10k-5

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	uA733H	50-uA733H
U2	74S113	54-74S113
U3	74LS196	54-74LS196
U4	74LS196	54-74LS196

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Y1	100-MHz Crystal	630-10
---	10-Pin Female PC Connector	551-71
---	14-Pin DIP Socket	553-63

TABLE 5-6. MARKER PROCESSOR PC ASSEMBLY 640-MS-5121

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	270pF, 100V, M	223-270
C2	1.0μF, 35V, T	250-19A
C3	4.7μF, 35V, T	250-39A
C4	27pF, 100V, M	223-27
C5	270pF, 100V, M	223-270
C6	.001μF, 100V, C	230-30
C7	.02μF, 100V, C	230-20
C8	390pF, 100V, M	223-390
C9	390pF, 100V, M	223-390
C10	390pF, 100V, M	223-390
C11	.001μF, 100V, C	230-30
C12	1.0μF, 35V, T	250-19A
C13	4.7μF, 35V, T	250-39A
C14	27pF, 100V, M	223-27
C15	100pF, 100V, M	223-100
C16	.001μF, 100V, C	230-30
C17	390pF, 100V, M	223-390
C18	390pF, 100V, M	223-390
C19	390pF, 100V, M	223-390
C20	1.0μF, 35V, T	250-19A
C21	4.7μF, 35V, T	250-39A
C22	27pF, 100V, M	223-27
C23	1.0μF, 35V, T	250-19A
C24	100pF, 100V, M	223-100
C25	.02μF, 100V, C	230-20
C26	390pF, 100V, M	223-390
C27	390pF, 100V, M	223-390
C28	390pF, 100V, M	223-390
C29	4.7μF, 35V, T	250-39A
C30	10μF, 35V, T	250-42A
C31	4.7μF, 35V, T	250-39A
C32	27pF, 100V, M	223-27

TABLE 5-6. MARKER PROCESSOR PC ASSEMBLY 640-MS-5121
(Continued)

C33	1.0μF, 35V, T	250-19A
C34	100pF, 100V, M	223-100
C35	390pF, 100V, M	223-390
C36	390pF, 100V, M	223-390
C37	390pF, 100V, M	223-390
C38	39pF, 100V, M	223-39
C39	68μF, 6V, T	250-58A
C40	10μF, 25V, T	250-42A

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	1N4446	10-1N4446
CR2	1N4446	10-1N4446
CR3	1N4446	10-1N4446
CR4	1N4446	10-1N4446
CR5	1N4446	10-1N4446
CR6	1N4446	10-1N4446
CR7	1N4446	10-1N4446
CR8	1N4446	10-1N4446

INDUCTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
L1	100μH	310-60

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	2N3565	20-2N3565
Q2	2N4249	20-2N4249
Q3	2N3565	20-2N3565
Q4	2N4249	20-2N4249
Q5	2N3565	20-2N3565
Q6	2N4249	20-2N4249
Q7	2N3565	20-2N3565
Q8	2N4249	20-2N4249

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	82, 1/8W, 5%, MF	109-82-5
R2	2.7k, 1/8W, 5%, MF	109-2.7k-5
R3	10k, 1/8W, 5%, MF	109-10k-5
R4	100k, 1/8W, 5%, MF	109-100k-5
R5	8.2k, 1/8W, 5%, MF	109-8.2k-5
R6	8.2k, 1/8W, 5%, MF	109-8.2k-5
R7	16k, 1/8W, 5%, MF	109-16k-5
R8	51k, 1/8W, 5%, MF	109-51k-5
R9	100k, 1/8W, 5%, MF	109-100k-5
R10	2.7k, 1/8W, 5%, MF	109-2.7k-5
R11	10k, 1/8W, 5%, MF	109-10k-5
R12	5.1k, 1/8W, 5%, MF	109-5.1k-5
R13	82, 1/8W, 5%, MF	109-82-5
R14	2.7k, 1/8W, 5%, MF	109-2.7k-5
R15	10k, 1/8W, 5%, MF	109-10k-5
R16	100k, 1/8W, 5%, MF	109-100k-5
R17	8.2k, 1/8W, 5%, MF	109-8.2k-5
R18	8.2k, 1/8W, 5%, MF	109-8.2k-5
R19	16k, 1/8W, 5%, MF	109-16k-5
R20	27k, 1/8W, 5%, MF	109-27k-5
R21	51k, 1/8W, 5%, MF	109-51k-5
R22	2.7k, 1/8W, 5%, MF	109-2.7k-5
R23	10k, 1/8W, 5%, MF	109-10k-5
R24	5.1k, 1/8W, 5%, MF	109-5.1k-5
R25	150, 1/8W, 5%, MF	109-150-5
R26	2.7k, 1/8W, 5%, MF	109-2.7k-5
R27	10k, 1/8W, 5%, MF	109-10k-5
R28	100k, 1/8W, 5%, MF	109-100k-5
R29	8.2k, 1/8W, 5%, MF	109-8.2k-5
R30	8.2k, 1/8W, 5%, MF	109-8.2k-5
R31	16k, 1/8W, 5%, MF	109-16k-5
R32	16k, 1/8W, 5%, MF	109-16k-5
R33	36k, 1/8W, 5%, MF	109-36k-5
R34	2.7k, 1/8W, 5%, MF	109-2.7k-5
R35	10k, 1/8W, 5%, MF	109-10k-5
R36	5.1k, 1/8W, 5%, MF	109-5.1k-5
R37	150, 1/8W, 5%, MF	109-150-5
R38	2.7k, 1/8W, 5%, MF	109-2.7k-5
R39	10k, 1/8W, 5%, MF	109-10k-5
R40	5.1k, 1/8W, 5%, MF	109-5.1k-5
R41	100k, 1/8W, 5%, MF	109-100k-5
R42	8.2k, 1/8W, 5%, MF	109-8.2k-5
R43	8.2k, 1/8W, 5%, MF	109-8.2k-5
R44	16k, 1/8W, 5%, MF	109-16k-5
R45	10k, 1/8W, 5%, MF	109-10k-5

TABLE 5-6. MARKER PROCESSOR PC ASSEMBLY 640-MS-5121 (Continued)

R46	27k, 1/8W, 5%, MF	109-27k-5
R47	2.7k, 1/8W, 5%, MF	109-2.7k-5
R48	10k, 1/8W, 5%, MF	109-10k-5
R49	5.1k, 1/8W, 5%, MF	109-5.1k-5
R50	51k, 1/8W, 5%, MF	109-51k-5
R51	51k, 1/8W, 5%, MF	109-51k-5
R52	51k, 1/8W, 5%, MF	109-51k-5
R53	51k, 1/8W, 5%, MF	109-51k-5
R54	10k, 1/8W, 5%, MF	109-10k-5
R55	51, 1/8W, 5%, MF	109-51-5
R56	2.7k, 1/8W, 5%, MF	109-2.7k-5
R57	16k, 1/8W, 5%, MF	109-16k-5
R58	7.5k, 1/8W, 5%, MF	109-7.5k-5
R59	390, 1/8W, 5%, MF	109-390-5
R60	390, 1/8W, 5%, MF	109-390-5
R61	82, 1/8W, 5%, MF	109-82-5

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	uA715	50-uA715
U2	96L02	54-96L02
U3	MC3302	54-MC3302
U4	74132	54-74132
U5	uA715	50-uA715
U6	96L02	54-96L02
U7	uA715	50-uA715
U8	uA715	50-uA715
U9	LM301A	50-LM301A

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	14-Pin DIP Plug	553-62

TABLE 5-7. 640T PLUG-IN

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R62	20kΩ, ±5%, 2W, WW (OFFSET)	150-20k
R94	10kΩ, ±5%, 2W, WW (ZERO dB SET)	150-10kA
R171	20k, 10%, 1/2W, CC (DISPLAY POSITION)	143-20k

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S2	Slide, DP3T (SMOOTHING)	430-53
S3	Slide, DPDT (OFFSET)	430-46
S4	Slide, DPDT (ZERO dB SET)	430-46
S5	Slide, SP6T with button (dB/DIV)	430-55

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Log Amplifier PC Assy	640-L-4625-3
---	Detector Assy: 50Ω BNC Version	640-MS-4945-1
---	Detector Assy: 50Ω N Version	640-MS-4945-2
---	Detector Assy: 75Ω BNC Version	640-MS-4946-1
---	Detector Assy: 75Ω N Version	640-MS-4946-2

TABLE 5-8. 640R PLUG-IN

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R62	20kΩ 5% 2W WW (OFFSET)	150-20k
R94	10kΩ 5% 2W WW (ZERO dB SET)	150-10kA
R171	20k 10% 1/2W CC (DISPLAY POSITION)	143-20k

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S2	Slide, DP3T (SMOOTHING)	430-53
S5	Slide, DP6T with button (dB/DIV)	430-55

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Log Amplifier PC Assy	640-L-4625-3
---	Autotester Assy: 50Ω BF	640-ML-4947-2
---	Autotester Assy: 50Ω NF	640-ML-4947-1
---	Autotester Assy: 75Ω BF	640-ML-4948-2
---	Autotester Assy: 75Ω NF	640-ML-4948-1

TABLE 5-9. 640E PLUG-IN

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R62	20kΩ 5% 2W WW (OFFSET)	150-20k
R94	10kΩ 5% 2W WW (ZERO dB SET)	150-10kA
R171	20k 10% 1/2W CC (DISPLAY POSITION)	143-20k

TABLE 5-9. 640E PLUG-IN (Continued)

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S2	Slide, DP3T (SMOOTHING)	430-53
S3	Slide, DPDT (OFFSET)	430-46
S4	Slide, DPDT (ZERO dB SET)	430-46
S5	Slide, SP6T with button (dB/DIV)	430-55

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Log Amplifier PC Assy	640-L-4625-3

LOG PLUG-IN HARDWARE

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	dB/DIV Knob	430-55A
---	DISPLAY POSITION Knob	710-45
---	ZERO dB SET Knob	710-54
---	Latch Assembly	2000-93

LINEAR PLUG-IN HARDWARE

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	mV/DIV Knob	430-55A
---	DISPLAY POSITION Knob	710-45
---	GAIN VERNIER Knob	710-54
---	Latch Assembly	2000-93

TABLE 5-10. LOG PC ASSEMBLY 640-L-4625

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	.1μF, 250V, My	210-30
C2	.01μF, 200V, My	210-20
C3	.22μF, 250V, My	210-31
C4	4.7μF, 35V, ±20%, T	250-39
C5	4.7μF, 35V, ±20%, T	250-39
C6	4.7μF, 35V, ±20%, T	250-39
C7	4.7μF, 35V, ±20%, T	250-39
C11	.1μF, 250V, My	210-30
C12	4.7μF, 35V, ±20%, T	250-39
C13	4.7μF, 35V, ±20%, T	250-39
C14	.001μF, 500V, C	230-3
C15	.047μF, 400V, My	210-31
C17	33pF, ±5%, M	220-33
C18	4.7μF, 35V, ±20%, T	250-39
C19	47μF, 6V, T	250-9
C20	4.7μF, 35V, ±20%, T	250-39
C21	33pF, ±5%, M	220-33
C22	33pF, ±5%, M	220-33
C23	.01μF, 100V, C	230-11
C24	.01μF, 100V, C	230-11
C25	4.7μF, 35V, ±20%, T	250-39
C26	33pF, ±5%, M	220-33
C27	33pF, ±5%, M	220-33
C28	.01μF, 100V, C	230-11
C29	.01μF, 100V, C	230-11
C30	.01μF, 100V, C	230-11
C31	.01μF, 100V, C	230-11
C32	10μF, 25V, ±10%, T	250-42
C33	10μF, 25V, ±10%, T	250-42
C34	--not used--	
C35	2700pF, 100V, ±10%, C	230-34
C36	.1μF, 250V, My	210-30
C37	270pF, 300V, 5%, M	220-270
C38	100pF, 300V, M	223-100
C39	100pF, 300V, M	223-100

C = Ceramic
M = Mica
My= Mylar
T = Tantalum

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	1N4446, S	10-1N4446
CR2	1N4446, S	10-1N4446
CR3	1N4446, S	10-1N4446
CR4	1N4446, S	10-1N4446
CR5	1N4446, S	10-1N4446
CR6	1N4446, S	10-1N4446
CR7	1N4446, S	10-1N4446
CR8	1N4446, S	10-1N4446
CR9	1N4446, S	10-1N4446
CR10	1N4446, S	10-1N4446
CR11	1N4446, S	10-1N4446
CR12	1N4446, S	10-1N4446
CR13	1N823, Z	10-1N823
CR14	1N751A, Z	10-1N751A
CR15	1N751A, Z	10-1N751A
CR16	1N746A, Z	10-1N746A
CR17	1N758A, Z	10-1N758A

S = Silicon
Z = Zener

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	-- not used --	---
Q2	J112-18	20-17
Q3	2N3565	20-2N3565
Q4	2N3565	20-2N3565
Q5	2N4249	20-2N4249
Q6	2N5195	20-2N5195
Q7	2N5192	20-2N5192
Q8	2N4249	20-2N4249
Q9	2N3694	20-2N3694
Q10	2N4249	20-2N4249
Q11	2N3565	20-2N3565
Q12	J112-18	20-17
Q13	2N3565	20-2N3565

TABLE 5-10. LOG PC ASSEMBLY 640-L-4625 (Continued)

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	51.1k, 1/4W, 1%, MF	110-51.1k-1
R2	51.1k, 1/4W, 1%, MF	110-51.1k-1
R3	51.1k, 1/4W, 1%, MF	110-51.1k-1
R4	5k variable	156-5KA
R5	178k, 1/4W, 1%, MF	110-178k-1
R6	--not used--	---
R9	100k, 1/4W, 1%, MF	110-100k-1
R10	3M, 1/4W, 5%, CC	101-3M-5
R13	20k, 1/8W, 0.1%,	118-20k-.1
R14	300k, 1/4W, 5%, CC	101-300k-1
R15	38.3k, 1/4W, 1%, MF	110-38.3k-1
R18	10k, 1/8W, 0.1%,	118-10k-.1
R19	6.49k, 1/4W, 1%, MF	110-6.49k-1
R20	--not used--	---
R21	20k variable	157-20KA
R22	--not used--	---
R23	10M, 1/4W, 5%, CC	101-10M-5
R25	20k, 1/8W, 0.1%,	118-20k-.1
R29	10k, 1/8W, 0.1%,	118-10k-.1
R30	150k, 1/4W, ±5%, CC	101-150k-5
R31	10k variable	156-10KA
R34	4.75k, 1/4W, 1%, MF	110-4.75k-1
R35	19.6k, 1/4W, 1%, MF	110-19.6k-1
R36	2.37k, 1/4W, 1%, MF	110-2.37k-1
R37	1.07k, 1/4W, 1%, MF	110-1.07k-1
R38	976, 1/4W, 1%, MF	110-976-1
R41	110k, 1/4W, 1%, MF	110-110k-1
R42	31.6k, 1/4W, 1%, MF	110-31.6k-1
R43	500 variable	157-500A
R44	1k, 1/4W, 1%, MF	110-1k-1
R45	100, 1/4W, 1%, MF	110-100-1
R46	20k variable	157-20KA
R47	100, 1/4W, 1%, MF	110-100-1
R51	20k variable	156-20KA
R52	100, 1/4W, 1%, MF	110-100-1
R53	10.5k, 1/4W, 1%, MF	110-10.5k-1
R61	10.0k, 1/4W, 1%, MF	110-10.0k-1
R62	20k, 1/4W, 1%, MF	110-20k-1
R65	14.3k, 1/4W, 1%, MF	110-14.3k-1
R66	14.3k, 1/4W, 1%, MF	110-14.3k-1
R67	1.02k, 1/4W, 1%, MF	110-1.02k-1
R68	976, 1/4W, 1%, MF	110-976-1
R71	5k, variable	110-5k-1
R72	5k, variable	110-5k-1
R73	20.0k, 1/4W, 1%, MF	110-20.0k-1
R74	1k, 1/4W, 1%, MF	110-1k-1
R75	20k variable	157-20KA
R76	100, 1/4W, 1%, MF	110-100-1
R77	31.6k, 1/4W, 1%, MF	110-31.6k-1
R78	100, 1/4W, 1%, MF	110-100-1
R79	42.2Ω, 1/4W, 1% MF	110-42.2-1
R80	10.0Ω, 1/4W, 1% MF	110-10.0-1
R83	24.9k, 1/4W, 1%, MF	110-24.9k-1
R84	-- not used --	---
R85	-- not used --	---
R86	-- not used --	---
R90	10k, 1/4W, .1%, MF	113-10k-.1
R91	100 variable	157-100A
R94	-- not used --	---
R95	1.02k, 1/4W, 1%, MF	110-1.02k-1
R96	976, 1/4W, 1%, MF	110-976-1
R99	8.06k, 1/4W, 1%, MF	110-8.06k-1
R100	10.0k, 1/4W, 1%, MF	110-10.0k-1
R101	4.02k, 1/4W, 1%, MF	110-4.02k-1
R102	9.09k, 1/4W, 1%, MF	110-9.09k-1
R103	1k, 1/4W, 1%, MF	110-1k-1
R104	100, 1/4W, 1%, MF	110-100-1
R105	100, 1/4W, 1%, MF	110-100-1
R106	100k, 1/4W, 1%, MF	110-100k-1
R107	3.3M, 1/4W, 5%, CC	101-3.3M-5
R108	2.37k, 1/4W, 1%, MF	110-2.37k-1
R111	-- not used --	---
R112	10.0k, 1/4W, .1%, MF	110-10k-.1
R113	20.0k, 1/4W, 1%, MF	110-20.0k-1
R114	49.9k, 1/4W, 1%, MF	110-49.9k-1
R115	100k, 1/4W, 1%, MF	110-100k-1
R116	200k, 1/4W, 1%, MF	110-200k-1
R117	499k, 1/4W, 1%, MF	110-499k-1
R118	3.74k, 1/4W, 1%, MF	110-3.74k-1
R119	31.6k, 1/4W, 1%, MF	110-31.6k-1
R120*	10M, 1/4W, 5%, CC	101-10M-5
R121	2.67k, 1/4W, 1%, MF	110-2.67k-1
R122*	5.1M, 1/4W, 5%, CC	101-5.1M-5
R123	50k variable	156-50KA
R124	100k, 1/4W, 1%, MF	110-100k-1
R128*	5.1M, 1/4W, 5%, CC	101-5.1M-5
R131	-- not used --	---
R132*	10M, 1/4W, 5%, CC	101-10M-5
R133	50k variable	156-50KA
R134	10.0k, 1/4W, 1%, MF	110-10.0k-1
R137	-- not used --	---
R138	1.18k, 1/4W, 1%, MF	110-1.18k-1
R139	5.62k, 1/4W, 1%, MF	110-5.62k-1
R140	51.1k, 1/4W, 1%, MF	110-51.1k-1
R141	3.65k, 1/4W, 1%, MF	110-3.65k-1
R142	7.32k, 1/4W, 1%, MF	110-7.32k-1
R143	14.7k, 1/4W, 1%, MF	110-14.7k-1

TABLE 5-10. LOG PC ASSY 640-L-4625
(Continued)

R144	1k variable	157-1KA
R145	10.0k, 1/4W, 1%, MF	110-10.0k-1
R146	5.62k, 1/4W, 1%, MF	110-5.62k-1
R147	51.1k, 1/4W, 1%, MF	110-51.1k-1
R152	--not used--	
R153	10.0k, 1/4W, 1%, MF	110-10.0k-1
R156	8.25k, 1/4W, 1%, MF	110-8.25k-1
R157	5.62k, 1/4W, 1%, MF	110-5.62k-1
R158	51.1k, 1/4W, 1%, MF	110-51.1k-1
R159	10.0k, 1/4W, 1%, MF	110-10.0k-1
R160	10.0k, 1/4W, .1%, MF	110-10k-.1
R161	10.0k, 1/4W, 1%, MF	110-10.0k-1
R162	6.81, 1/4W, 1% MF	110-6.81-1
R163	5.11, 1/4W, 1% MF	110-5.11-1
R164	14.7k, 1/4W, 1%, MF	110-14.7k-1
R165	10.0k, 1/4W, 1%, MF	110-10.0k-1
R166	10.0k, 1/4W, 1%, MF	110-10.0k-1
R167	10.0k, 1/4W, 1%, MF	110-10.0k-1
R168	51.1k, 1/4W, 1%, MF	110-51.1k-1
R169	100k, 1/4W, 1%, MF	110-100k-1
R170	10.0k, 1/4W, .1%, MF	110-10k-.1
R171	--not used--	
R172	51.1k, 1/4W, 1%, MF	110-51.1k-1
R173	19.1k, 1/4W, 1%, MF	110-19.1k-1
R174	100, 1/4W, 1%, MF	110-100-1
R175	1k, 1/4W, 1%, MF	110-1k-1
R176	1k, 1/4W, 1%, MF	110-1k-1
R177	3.16k, 1/4W, 1%, MF	110-3.16k-1
R178	100k, 1/4W, 1%, MF	110-100k-1
R179	1k, 1/4W, 1%, MF	110-1k-1
R180	1M, 1/4W, 1%, MF	110-1M-1-A
R181	124k, 1/4W, 1%, MF	110-124k-1
R182	1M, 1/4W, 1%, MF	110-1M-1-A
R183	100, 1/4W, 1%, MF	110-100-1
R184	15.8k, 1/4W, 1%, MF	110-15.8k-1
R185	4.99k, 1/4W, 1%, MF	110-4.99k-1
R186	3.32k, 1/4W, 1%, MF	110-3.32k-1
R187	100k, 1/4W, 1%, MF	110-100k-1
R188	1k, 1/8W, 5%, MF	109-1k-5
R189	10k, 1/8W, 5%, MF	109-10k-5
R190	10k, 1/8W, 5%, MF	113-10k-5

CC = Carbon Composite
MF = Metal Film
* = Factory-select

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	AD510J	50-1
U3	1458	50-1458
U5	AD517JH	50-13
U7	μA725C	50-μA725C
U9	LM301A	50-LM301A
U10	LM301A	50-LM301A
U12	LM301A	50-LM301A
U13	LM301A	50-LM301A
U14	LM301A	50-LM301A
U15	1458	50-1458
U16	LH0042CH	50-12

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
S1	Switch, DPDT	430-54
S7	Switch, DPDT	430-46

TABLE 5-11. 640L PLUG-IN

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R92	20k, 5%, 2W, WW (OFFSET)	150-20k
R93	2.5k, 10%, 1W (GAIN VERNIER)	155-2.5k
R94	20k, 10%, 1/2W, CC (DISPLAY POSITION)	143-20k

WW = Wirewound
CC = Carbon Composition

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S1	Slide, SP6T	430-55
S4	Slide, DP3T	430-53

CONNECTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	BNC, insulated	510-31
---	5-Pin Jack	551-80

TABLE 5-12. LINEAR PC ASSEMBLY 640-L-6269

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	33pF, 300V, M	220-33
C2	4.7μF, 35V, T	250-39
C3	4.7μF, 35V, T	250-39
C4	4.7μF, 35V, T	250-39
C5	4.7μF, 35V, T	250-39
C8	4.7μF, 35V, T	250-39
C9	4.7μF, 35V, T	250-39
C12	4.7μF, 35V, T	250-39
C13	4.7μF, 35V, T	250-39
C14	33pF, 300V, M	220-33
C15	.0027μF, 100V, C	230-34
C16	.56μF, 100V, My	210-43
C17	47pF, 300V, M	220-47
C18	33pF, 300V, M	220-33
C19	.01μF, 100V, C	230-11
C20	.01μF, 100V, C	230-11
C25	4.7μF, 35V, T	250-39
C26	33pF, 300V, M	220-33
C27	33pF, 300V, M	220-33
C28	.01μF, 100V, C	230-11
C29	.01μF, 100V, C	230-11
C30	.01μF, 100V, C	230-11
C31	.01μF, 100V, C	230-11
C32	10μF, 25V, T	250-42
C33	10μF, 25V, T	250-42

C = Ceramic
M = Mica
My = Mylar
T = Tantalum

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	1N4446, S	10-1N4446
CR2	1N4446, S	10-1N4446
CR3	1N4446, S	10-1N4446
CR4	1N4446, S	10-1N4446
CR5	1N4446, S	10-1N4446
CR6	1N4446, S	10-1N4446
CR7	1N755A, Z, 7.5V, .4W, 5%	10-1N755A
CR8	1N4446, S	10-1N4446
CR13	1N823, Z, 6.2V, .4W, 5%	10-1N823
CR14	1N751A, Z, 5.1V, .4W, 5%	10-1N751A
CR15	1N751A, Z, 5.1V, .4W, 5%	10-1N751A

S = Silicon
Z = Zener

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	2N5047	20-2N5047
Q2	J112	20-17
Q3	2N3565	20-2N3565
Q4	2N3565	20-2N3565
Q5	2N4249	20-2N4249
Q6	2N5195	20-2N5195
Q7	2N5192	20-2N5192
Q8	2N4249	20-2N4249
Q9	2N3694	20-2N3694
Q10	2N4249	20-2N4249
Q11	2N3565	20-2N3565
Q12	J112	20-17
Q13	2N3565	20-2N3565
Q14	2N4249	20-2N4249

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	34.8k, 1/4W, 1%, MF	110-34.8k-1
R2	20k, 1/4W, 1%, MF	110-20k-1
R3	20k, 1/4W, 1%, MF	110-20k-1
R4	255k, 1/4W, 1%, MF	110-255k-1
R5	32.4k, 1/4W, 1%, MF	110-32.4k-1
R6	20k, 1/4W, 1%, MF	110-20k-1
R7	20k, 1/4W, 1%, MF	110-20k-1
R8	33.2k, 1/4W, 1%, MF	110-33.2k-1
R9	51.1k, 1/4W, 1%, MF	110-51.1k-1
R10	255k, 1/4W, 1%, MF	110-255k-1
R11	30.1k, 1/4W, 1%, MF	110-30.1k-1
R12	5.1M, 1/4W, 5%, CC	101-5.1M-5
R13	49.9k, 1/4W, 1%, MF	110-49.9k-1
R14	100, 1/4W, 1%, MF	110-100-1
R15	100, 1/4W, 1%, MF	110-100-1
R16	100, 1/4W, 1%, MF	110-100-1
R17	15.8k, 1/4W, 1%, MF	110-15.8k-1
R18	196, 1/4W, 1%, MF	110-196-1
R19	1.1k, 1/4W, 1%, MF	110-1.1k-1
R20	10k, 1/4W, 1%, MF	110-10k-1
R21	20k, variable	157-20kA
R22	1k, 1/4W, 1%, MF	110-1k-1
R23	100, 1/4W, 1%, MF	110-100-1
R24	100, 1/4W, 1%, MF	110-100-1
R27	1.1k, 1/4W, 1%, MF	110-1.1k-1
R28	21k, 1/4W, 1%, MF	110-21k-1
R29	1k, 1/4W, 1%, MF	110-1k-1
R30	100, 1/4W, 1%, MF	110-100-1

TABLE 5-12. LINEAR PC ASSEMBLY 640-L-6269 (Continued)

R31	100, 1/4W, 1%, MF	110-100-1
R34	1k, 1/4W, 1%, MF	110-1k-1
R35	100, 1/4W, 1%, MF	110-100-1
R36	100k, 1/4W, 1%, MF	110-100k-1
R37	100, 1/4W, 1%, MF	110-100-1
R38	100, 1/4W, 1%, MF	110-100-1
R39	5.1M, 1/4W, 5%, CC	101-5.1M-5
R40	10M, 1/4W, 5%, CC	101-10M-5
R41	100, 1/4W, 1%, MF	110-100-1
R42	100k, 1/4W, 1%, MF	110-100k-1
R43	10k, 1/4W, 1%, MF	110-10k-1
R44	10k, 1/4W, 1%, MF	110-10k-1
R45	100k, 1/4W, 1%, MF	110-100k-1
R46	20k, variable	157-20kA
R47	10, 1/4W, 1%, MF	110-10-1
R48	1k, 1/4W, 1%, MF	110-1k-1
R49	1k, 1/4W, 1%, MF	110-1k-1
R50	953, 1/4W, 1%, MF	110-953-1
R51	100k, 1/4W, 1%, MF	110-100k-1
R52	24.9k, 1/4W, 1%, MF	110-24.9k-1
R53	100k, 1/4W, 1%, MF	110-100k-1
R54	24.9k, 1/4W, 1%, MF	110-24.9k-1
R55	100k, 1/4W, 1%, MF	110-100k-1
R56	20k, 1/4W, 1%, MF	110-20k-1
R57	95.3k, 1/4W, 1%, MF	110-95.3k-1
R58	10k, 1/4W, 1%, MF	110-10k-1
R59	10M, 1/4W, 5%, CC	101-10M-5
R60	5.1M, 1/4W, 5%, CC	101-5.1M-5
R61	10k, 1/4W, 1%, MF	110-10k-1
R62	10k, 1/4W, 1%, MF	110-10k-1
R63	4.99k, 1/4W, 1%, MF	110-4.99k-1
R64	10k, 1/4W, 1%, MF	110-10k-1
R65	10k, 1/4W, 1%, MF	110-10k-1
R66	3.32, 1/4W, 1%, MF	110-3.32k-1
R67	10k, 1/4W, 1%, MF	110-10k-1
R68	100, 1/4W, 1%, MF	110-100-1
R69	100k, 1/4W, 1%, MF	110-100k-1
R70	51.1k, 1/4W, 1%, MF	110-51.1k-1
R71	10k, 1/4W, 1%, MF	110-10k-1
R72	10k, variable	156-10kA
R73	51.1k, 1/4W, 1%, MF	110-51.1k-1
R74	10k, 1/4W, 1%, MF	110-10k-1
R75	20k, variable	157-20kA
R76	100k, 1/4W, 1%, MF	110-100k-1
R77	19.1k, 1/4W, 1%, MF	110-19.1k-1
R78	1k, 1/4W, 1%, MF	110-1k-1
R79	51.1k, 1/4W, 1%, MF	110-51.1k-1
R80	1k, 1/4W, 1%, MF	110-1k-1
R81	10k, 1/4W, 1%, MF	110-10k-1
R82	51.1k, 1/4W, 1%, MF	110-51.1k-1
R83	51.1k, 1/4W, 1%, MF	110-51.1k-1
R84	10k, variable	156-10kA
R85	51.1k, 1/4W, 1%, MF	110-51.1k-1
R87	51.1k, 1/4W, 1%, MF	110-51.1k-1
R89	51.1k, 1/4W, 1%, MF	110-51.1k-1
R90	51.1k, 1/4W, 1%, MF	110-51.1k-1
R91	100, variable	157-100A
R123	50k, variable	156-50kA
R133	50k, variable	156-50kA
R138	1.18k, 1/4W, 1%, MF	110-1.18k-1
R139	5.62k, 1/4W, 1%, MF	110-5.62k-1
R141	3.65k, 1/4W, 1%, MF	110-3.65k-1
R142	7.32k, 1/4W, 1%, MF	110-7.32k-1
R143	14.7k, 1/4W, 1%, MF	110-14.7k-1
R144	1k, variable	157-1kA
R146	5.62k, 1/4W, 1%, MF	110-5.62k-1
R156	8.25k, 1/4W, 1%, MF	110-8.25k-1
R157	5.62k, 1/4W, 1%, MF	110-5.62k-1
R162	6.81k, 1/4W, 1%, MF	110-6.81k-1
R163	5.11, 1/4W, 1%, MF	110-5.11-1
R164	14.7k, 1/4W, 1%, MF	110-14.7k-1
R177	3.16k, 1/4W, 1%, MF	110-3.16k-1

CC = Carbon Composition
MF = Metal Film

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	LF356H	50-2
U5	LF356H	50-2
U7	LF356H	50-2
U9	LM301A	50-LM301A
U10	LM301A	50-LM301A
U12	LM301A	50-LM301A
U13	LM301A	50-LM301A
U14	LM301A	50-LM301A
U15	1458	50-1458

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S2	Slide, DPDT	430-54
S3	Slide, DPDT	430-46

SECTION VI
SCHEMATIC DIAGRAMS

6-1 INTRODUCTION

This section of the manual contains the schematic diagrams for the Model 640 RF Analyzer. Table 6-1 lists all the drawings included in this section of the manual.

Table 6-1. List of Drawings and Schematics

Figure	Title	Page
6-1	Mainframe Interface Board	6-3
6-2	Mainframe Low-Voltage Power Supply	6-5
6-3	Mainframe Auxiliary Board	6-7
6-4	Mainframe Vertical and Horizontal Deflection Amplifiers	6-9
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6-6	Sweep Generator Plug-In, Ramp Generator	6-13
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6-8	Sweep Generator Plug-In, Linearizer	6-17
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6-12	Marker RF Board	6-25/6-26
6-13	Marker Processor Board	6-27/6-28
6-14	Log Plug-In, RF Components	6-29
6-15	Log Plug-In, Preamplifier	6-31
6-16	Log Plug-In, Processor	6-33
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6-18	Linear Plug-In, Amplifier	6-37
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VOLTAGE AND WAVEFORM CONDITIONS

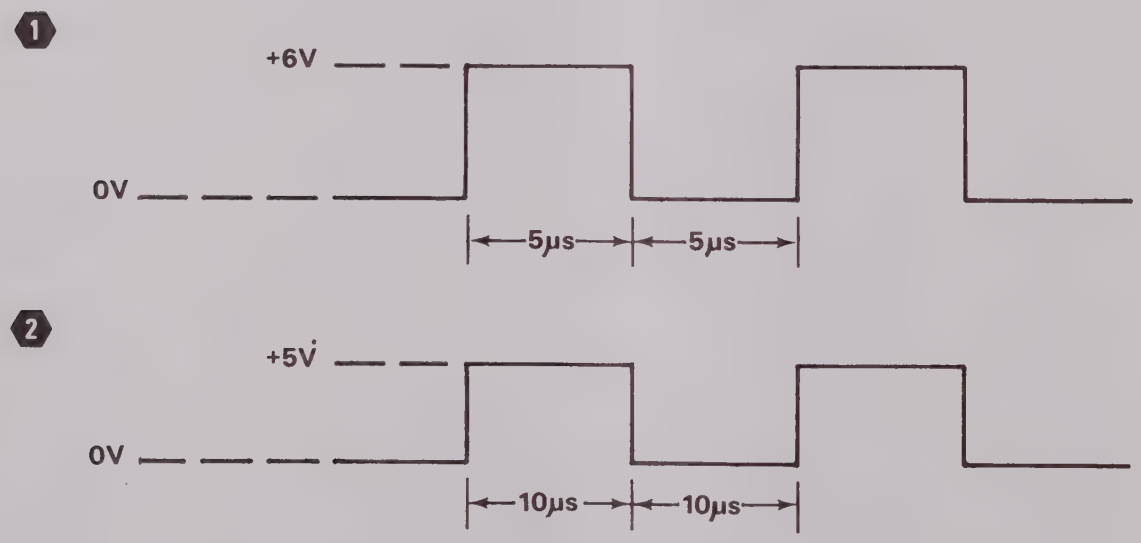
WARNING

High voltage is present at several points in the instrument. Therefore, do not touch exposed connections or components.

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		



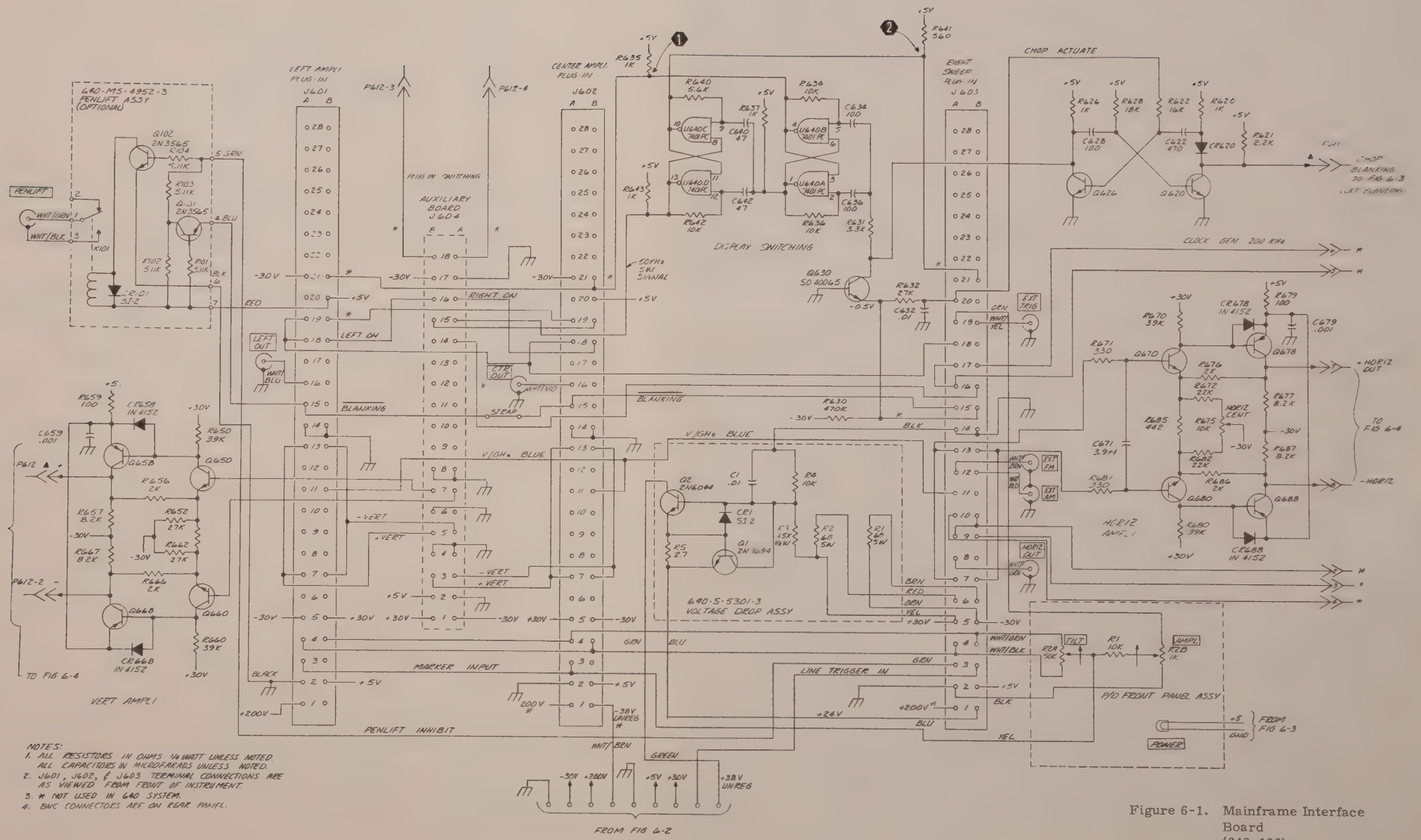


Figure 6-1. Mainframe Interface Board (640-100)

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

High voltage is present at several points in the instrument. Therefore, do not touch exposed connections or components.

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		

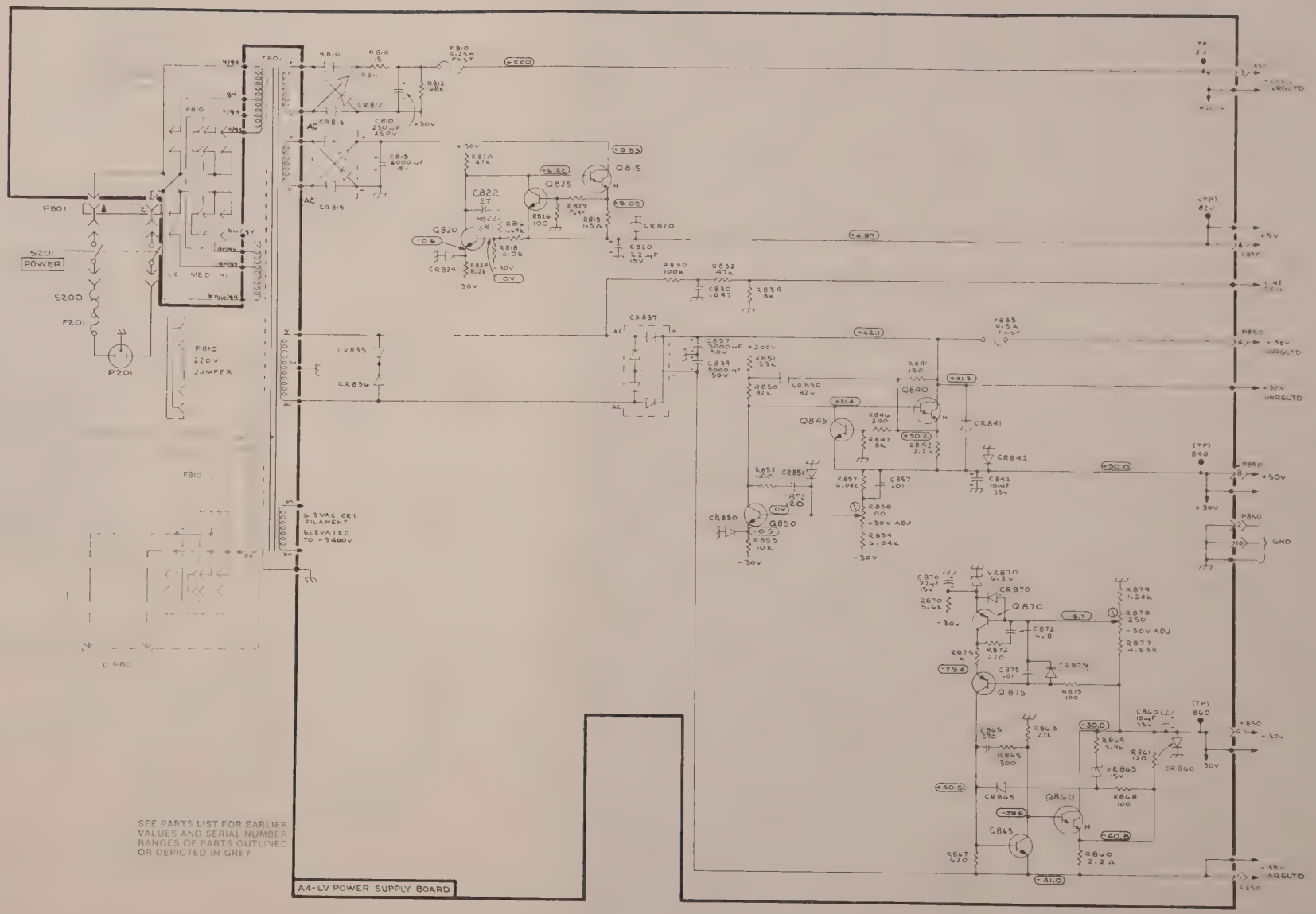


Figure 6-2. Mainframe Low-Voltage Power Supply

Δ - See Manual Title Page
5-640-OMM

VOLTAGE AND WAVEFORM CONDITIONS

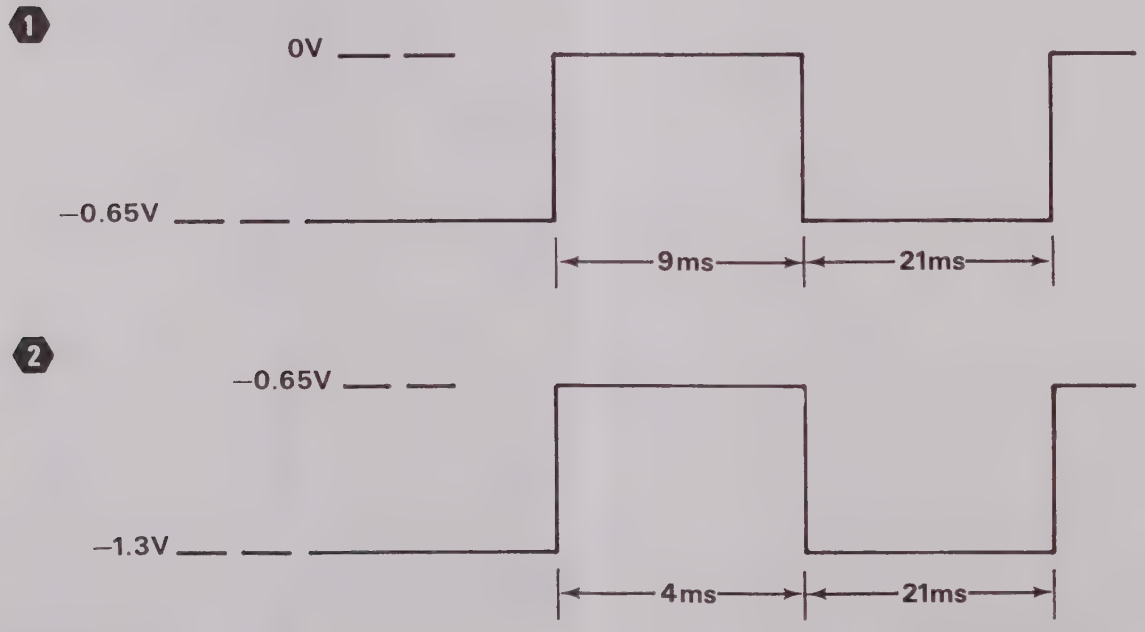
WARNING

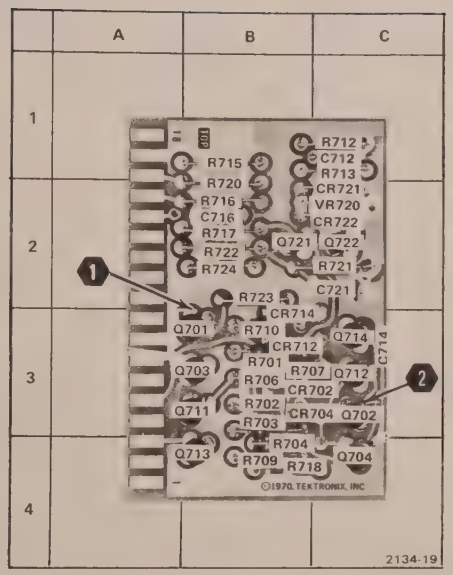
High voltage is present at several points in the instrument. Therefore, do not touch exposed connections or components.

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		





A2—Single Beam Auxiliary circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC
C712	C-1	Q721	B-2
C714†	C-3	Q722	C-2
C716	B-2		
C721	C-2	R701	B-3
		R702	B-3
CR702	C-3	R703	B-3
CR704	C-3	R704	B-4
CR712	B-3	R706	B-3
CR714	B-3	R707	B-3
CR721	C-2	R709	B-4
CR722	C-2	R710	B-3
		R712	C-1
VR720	C-2	R713	C-1
		R715	B-1
Q701	B-3	R716	B-2
Q702	C-3	R717	B-2
Q703	B-3	R718	B-4
Q704	C-4	R720	B-2
Q711	B-3	R721	C-2
Q712	C-3	R722	B-2
Q713	B-4	R723	B-2
Q714	C-3	R724	B-2

†Located on back of board.

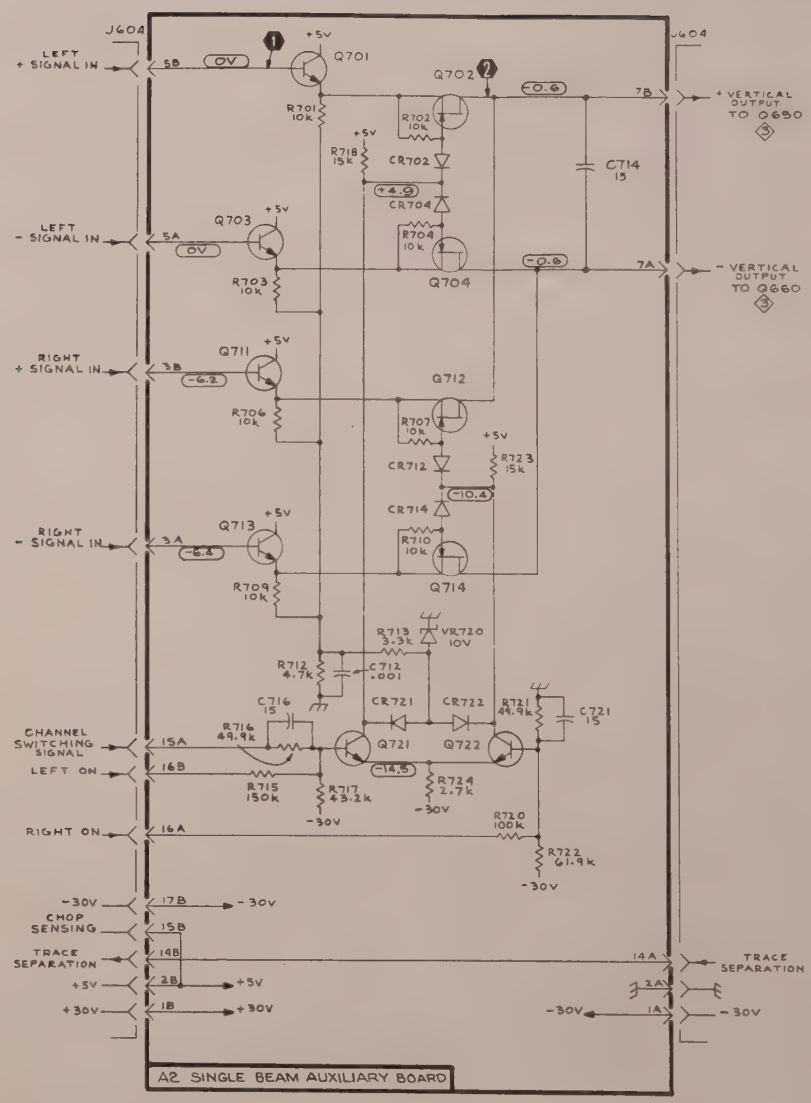


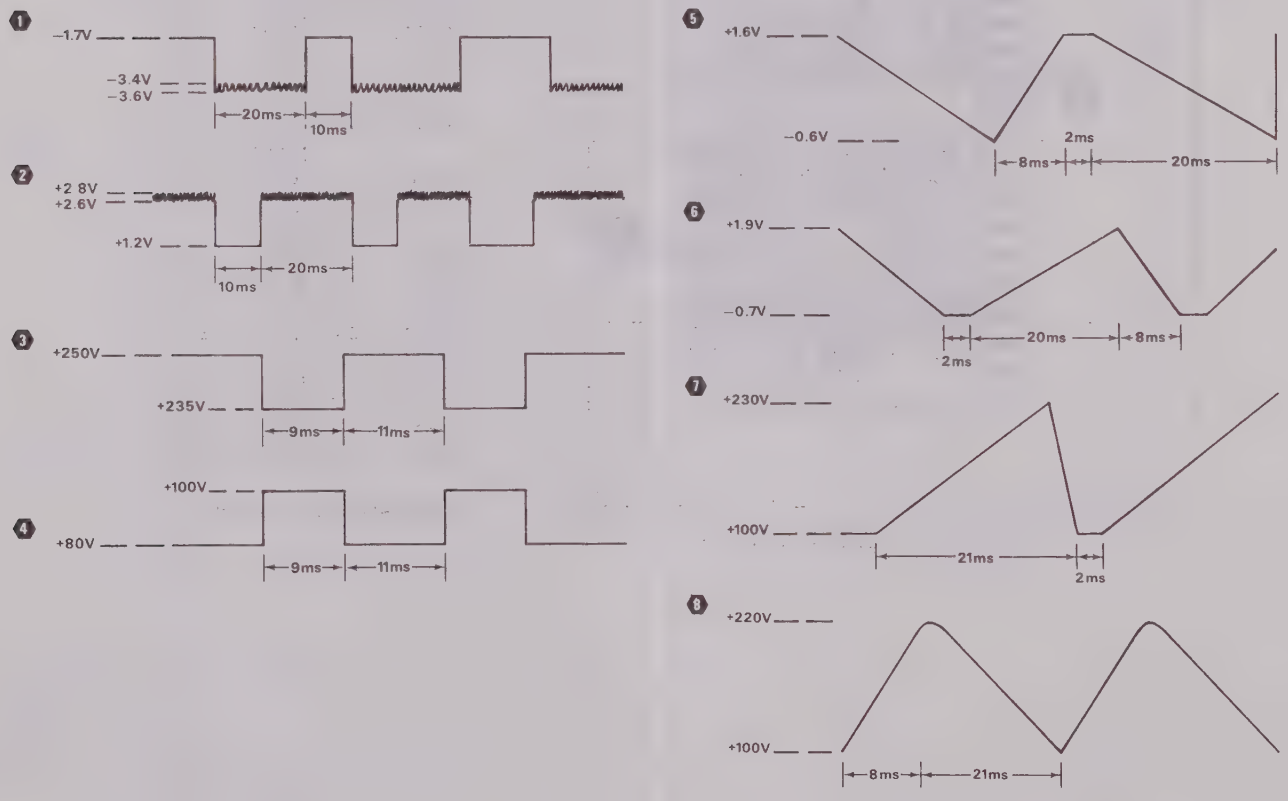
Figure 6-3. Mainframe Auxiliary Board

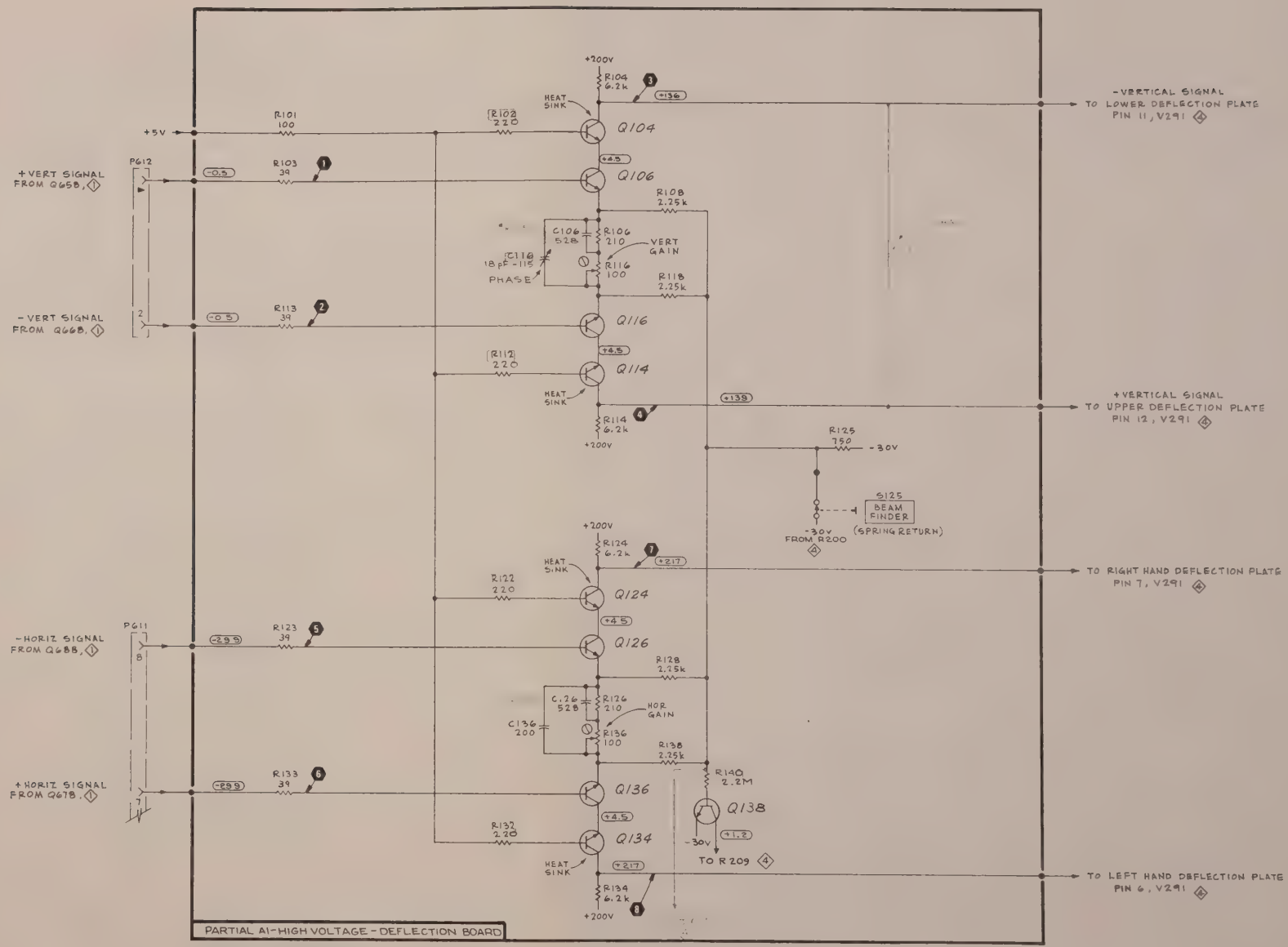
VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		





SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY

Figure 6-4. Mainframe Vertical and Horizontal Deflection Amplifiers

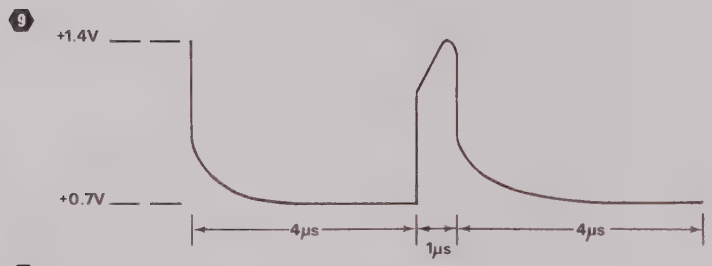
Δ- See Manual Title Page

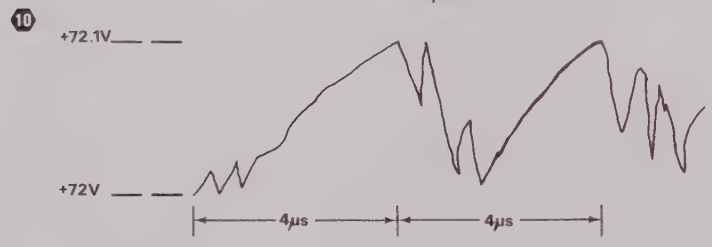
VOLTAGE AND WAVEFORM CONDITIONS

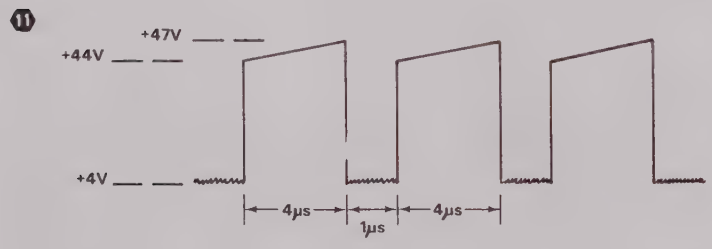
Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

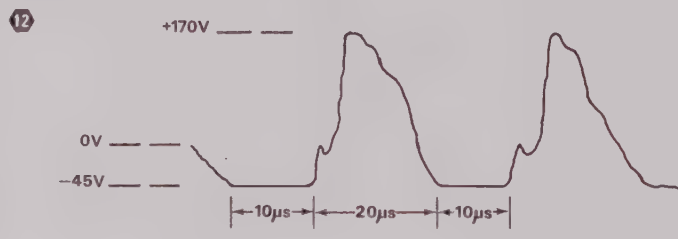
Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

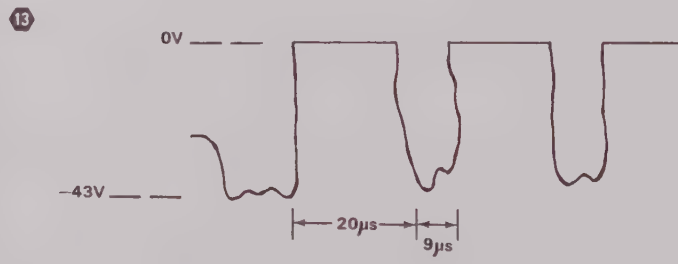
640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		

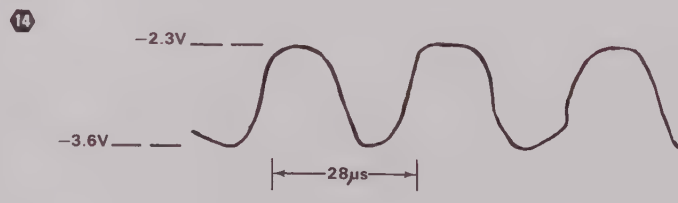












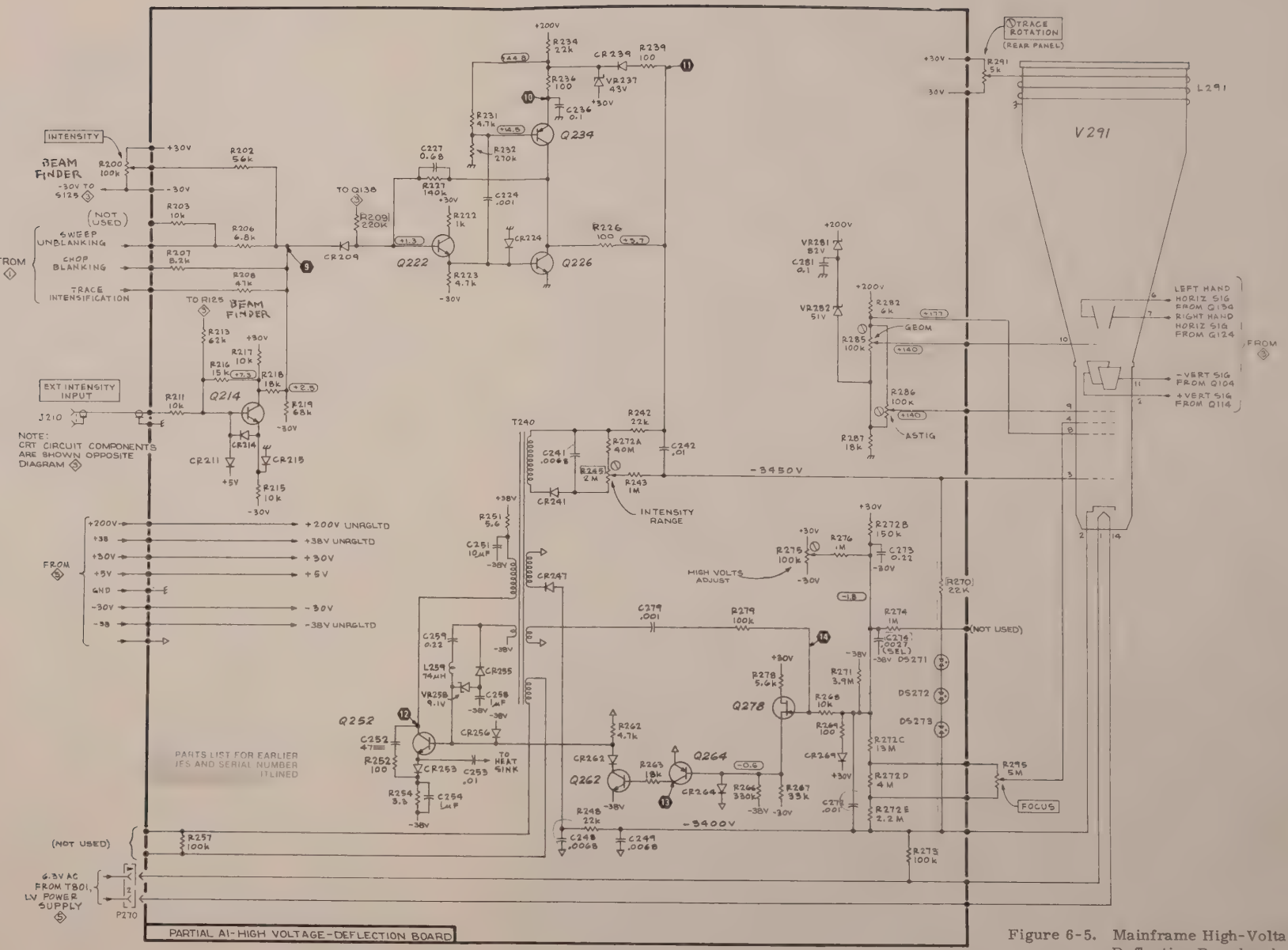


Figure 6-5. Mainframe High-Voltage Deflection Board and CRT Circuit

Δ- See Manual Title Page
5-640-OMM

VOLTAGE AND WAVEFORM CONDITIONS

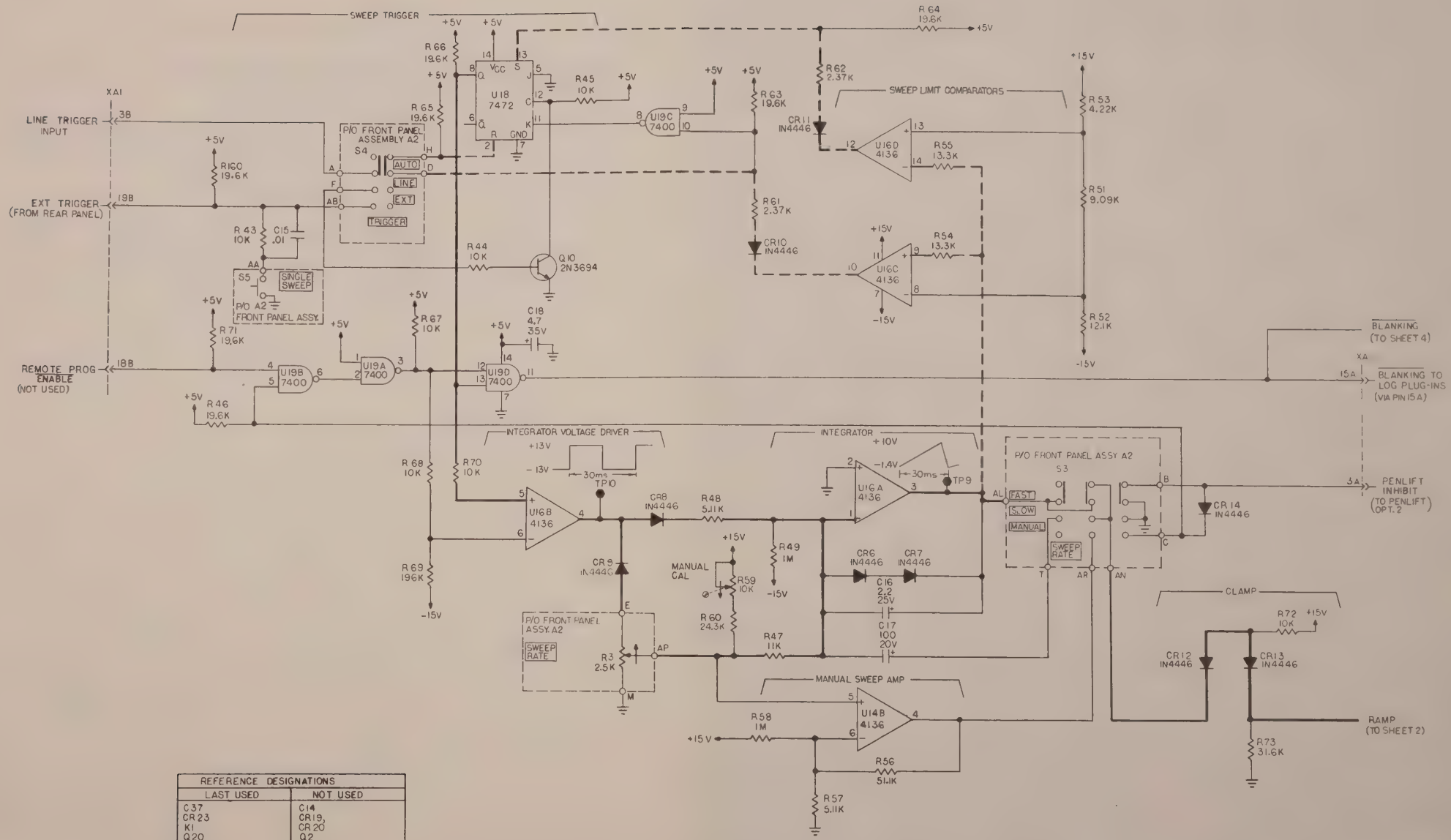
WARNING

High voltage is present at several points in the instrument. Therefore, do not touch exposed connections or components.

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		



REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C37	C14
CR23	CR19,
K1	CR20
Q20	Q2
R203	R165, R50
TP21	R176
U21	R177

Figure 6-6. Sweep Generator Plug-In, Ramp Generator (640G-A1/1)

VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		

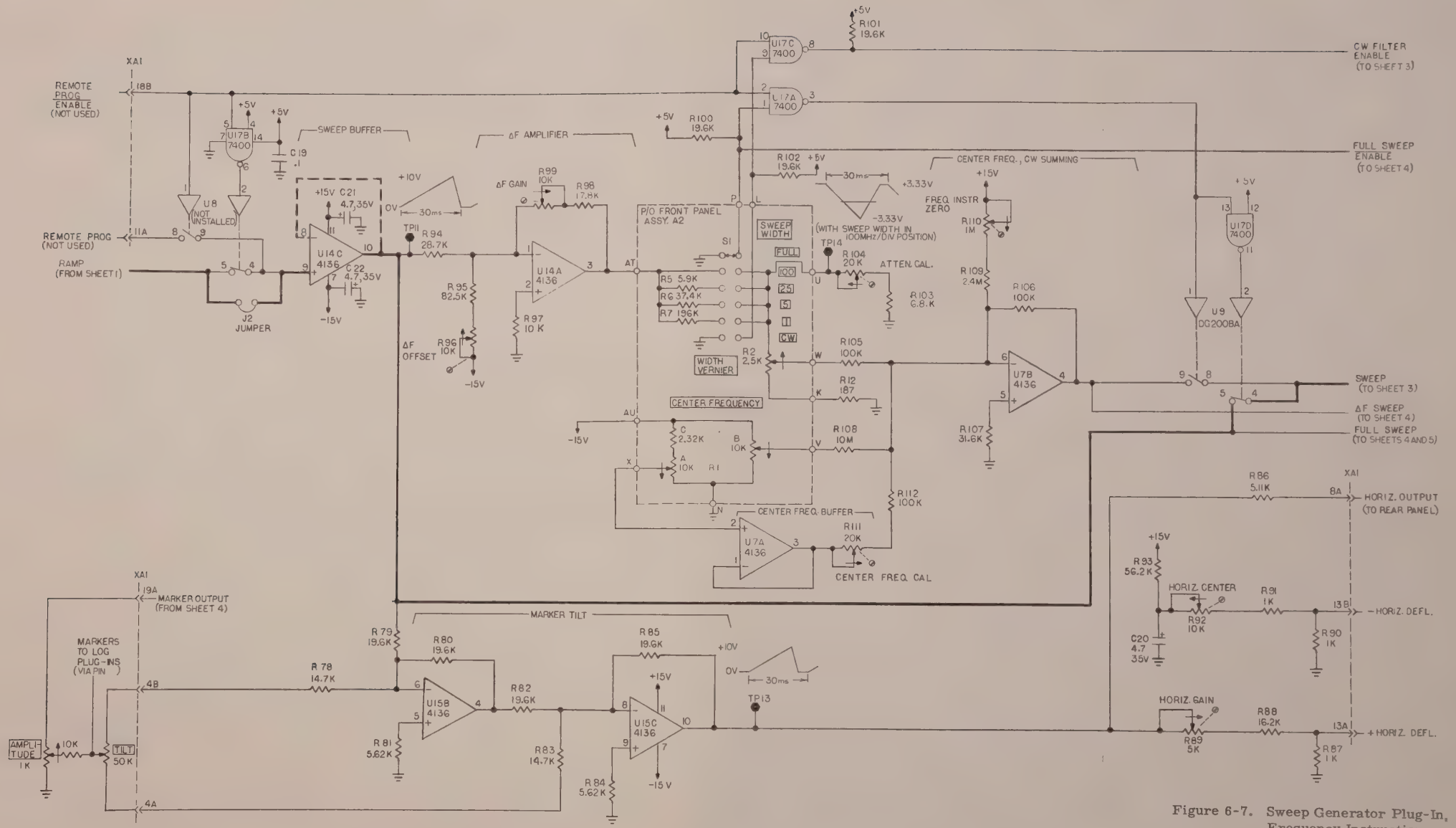


Figure 6-7. Sweep Generator Plug-In, Frequency Instruction (640G-A1/2)

VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		

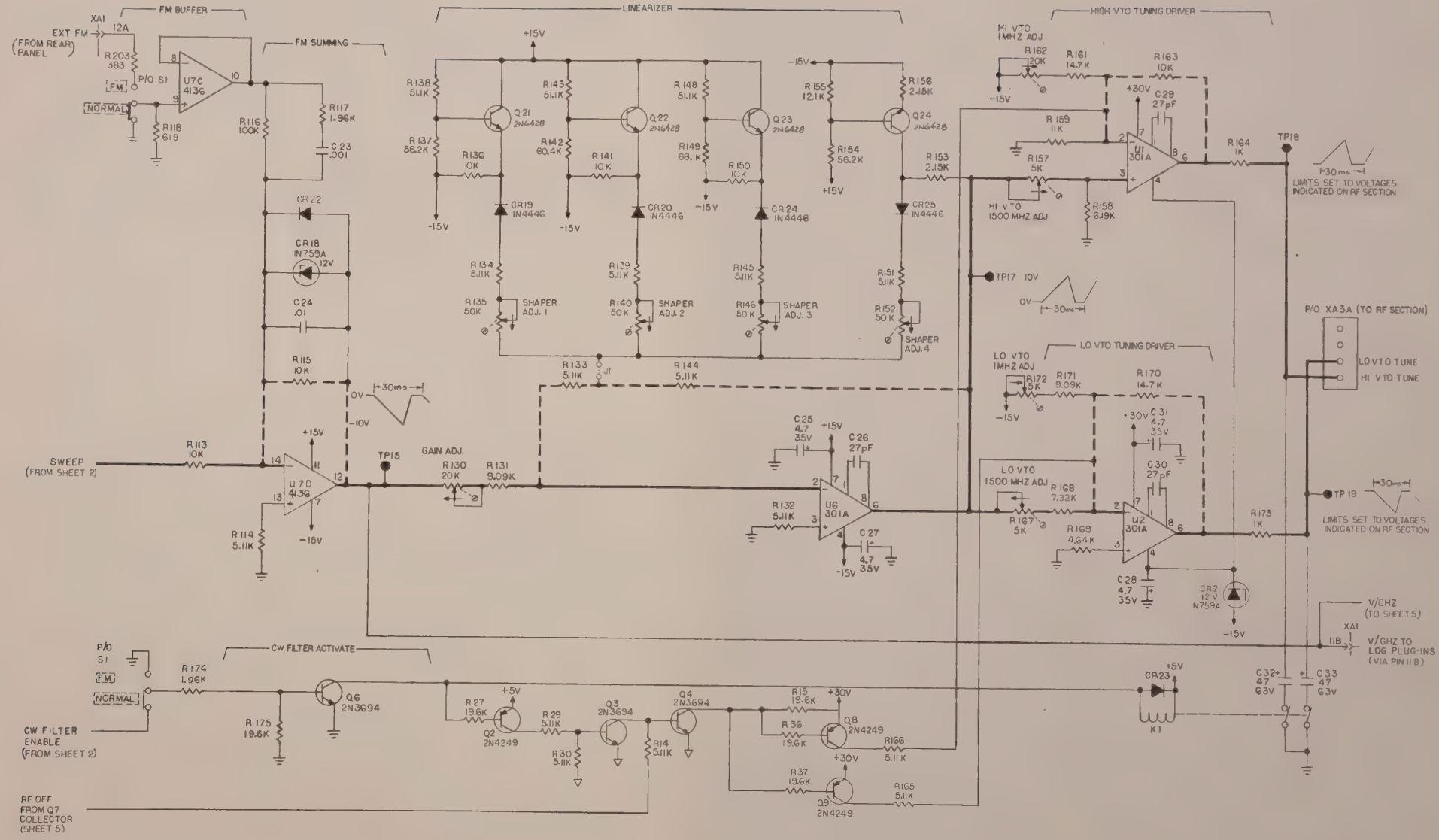


Figure 6-8. Sweep Generator Plug-In, Linearizer (640G-A1/3)

VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		

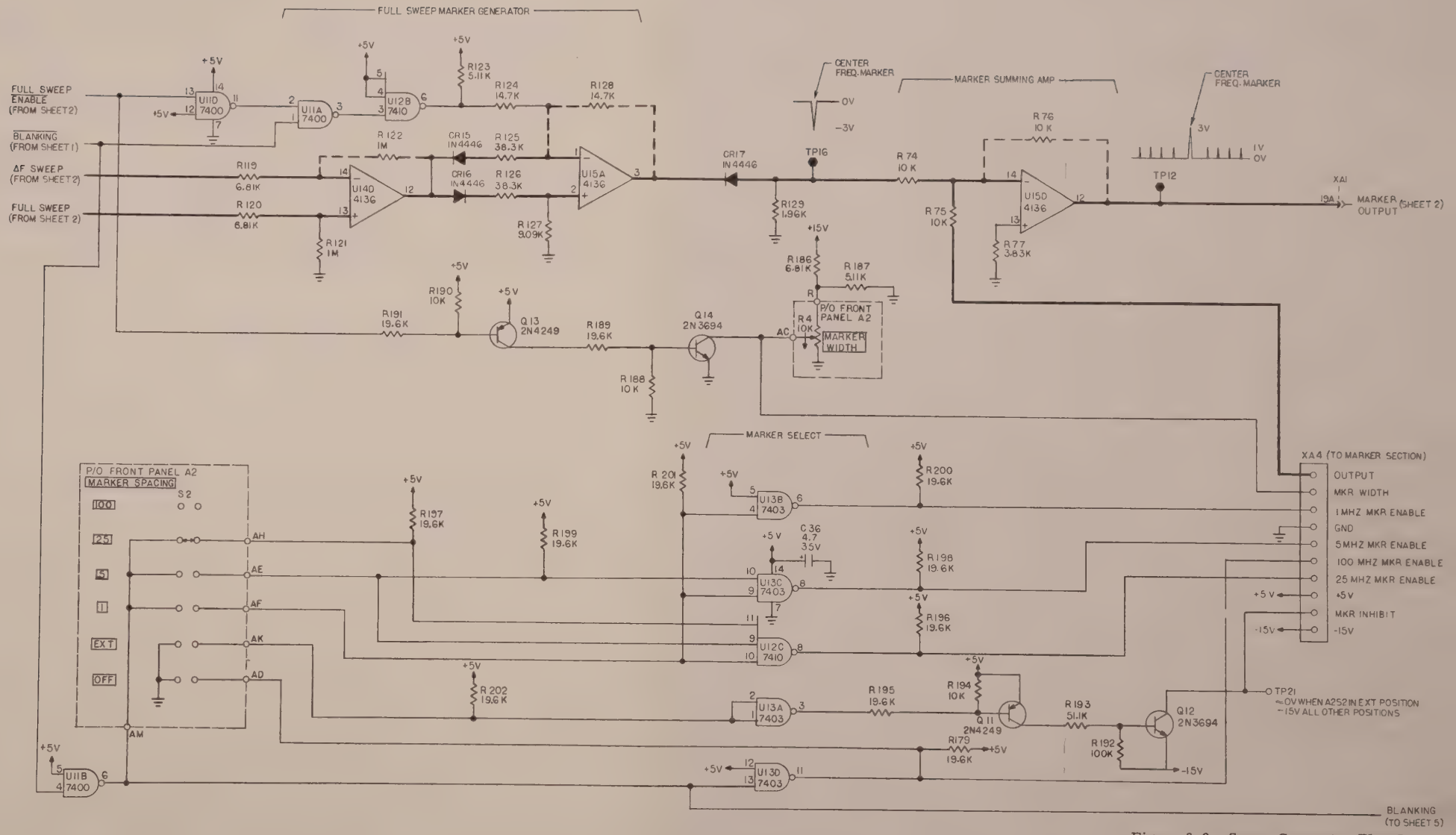


Figure 6-9. Sweep Generator Plug-In, Marker Control (640G-A1/4)

VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		

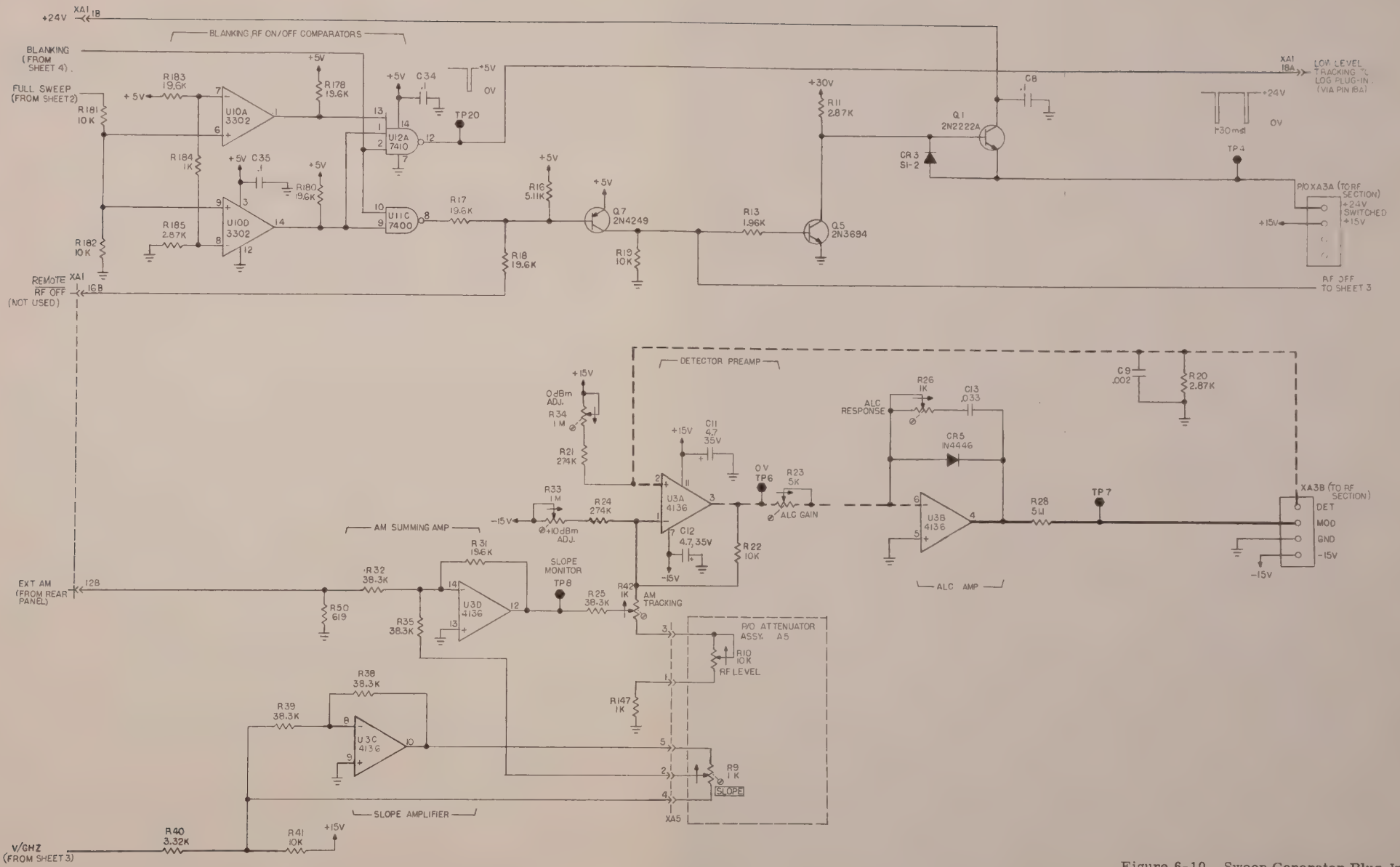


Figure 6-10. Sweep Generator Plug-In, ALC (640G-A1/5)

VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		

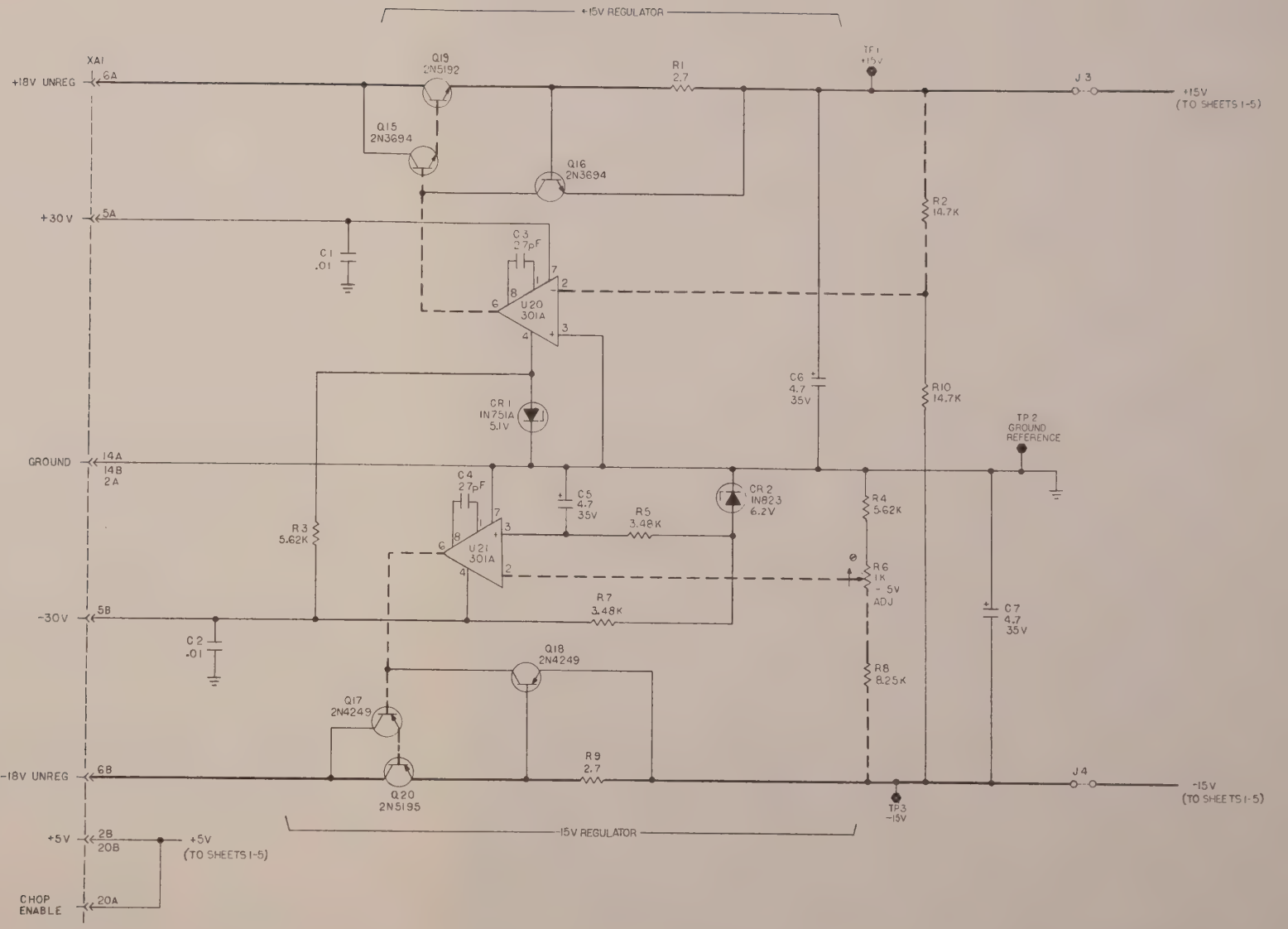


Figure 6-11 Sweep Generator Plug-In, ± 15 V Regulators (640G-A1/6)

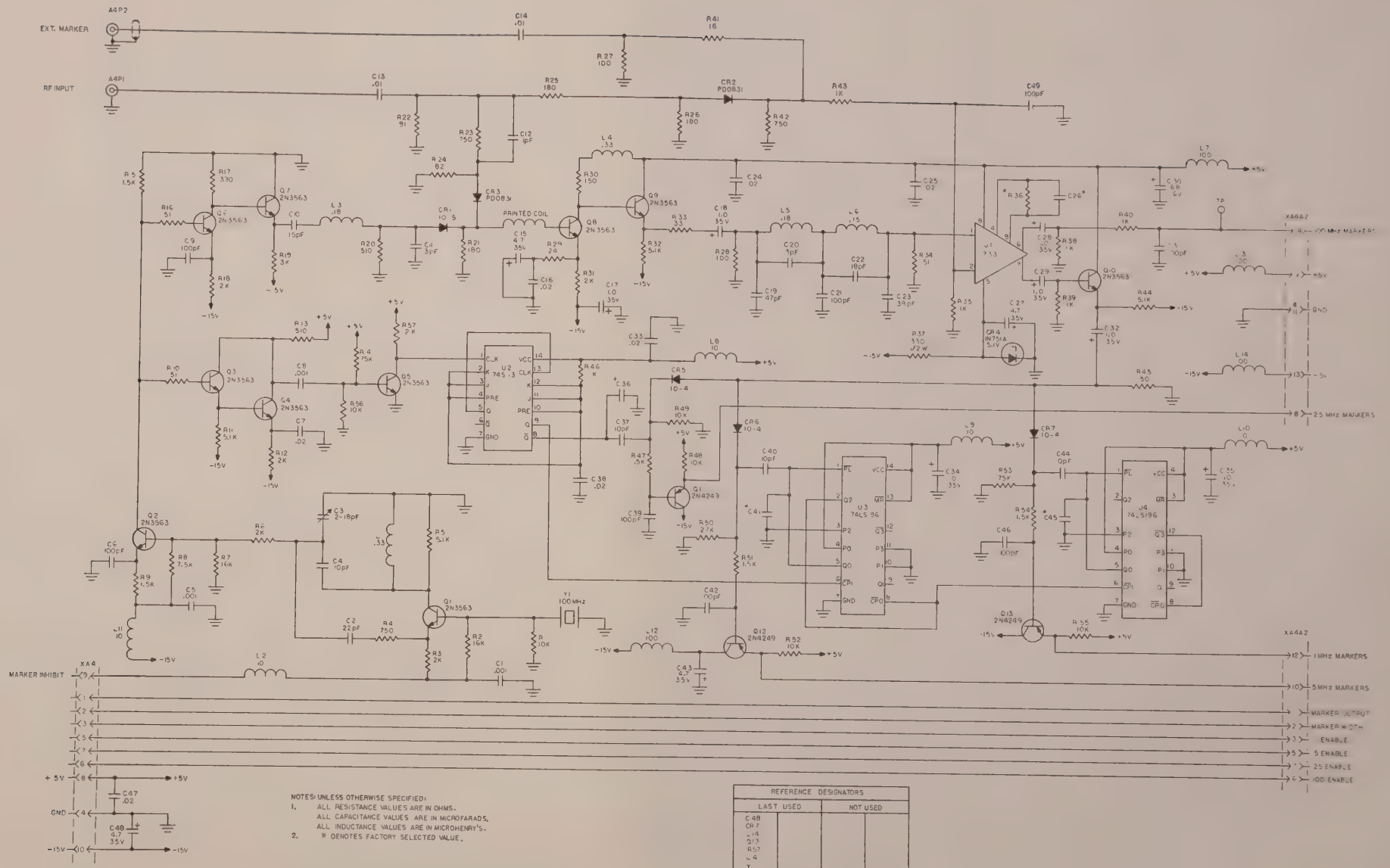


Figure 6-12. Marker RF Board (640G-A3/1)

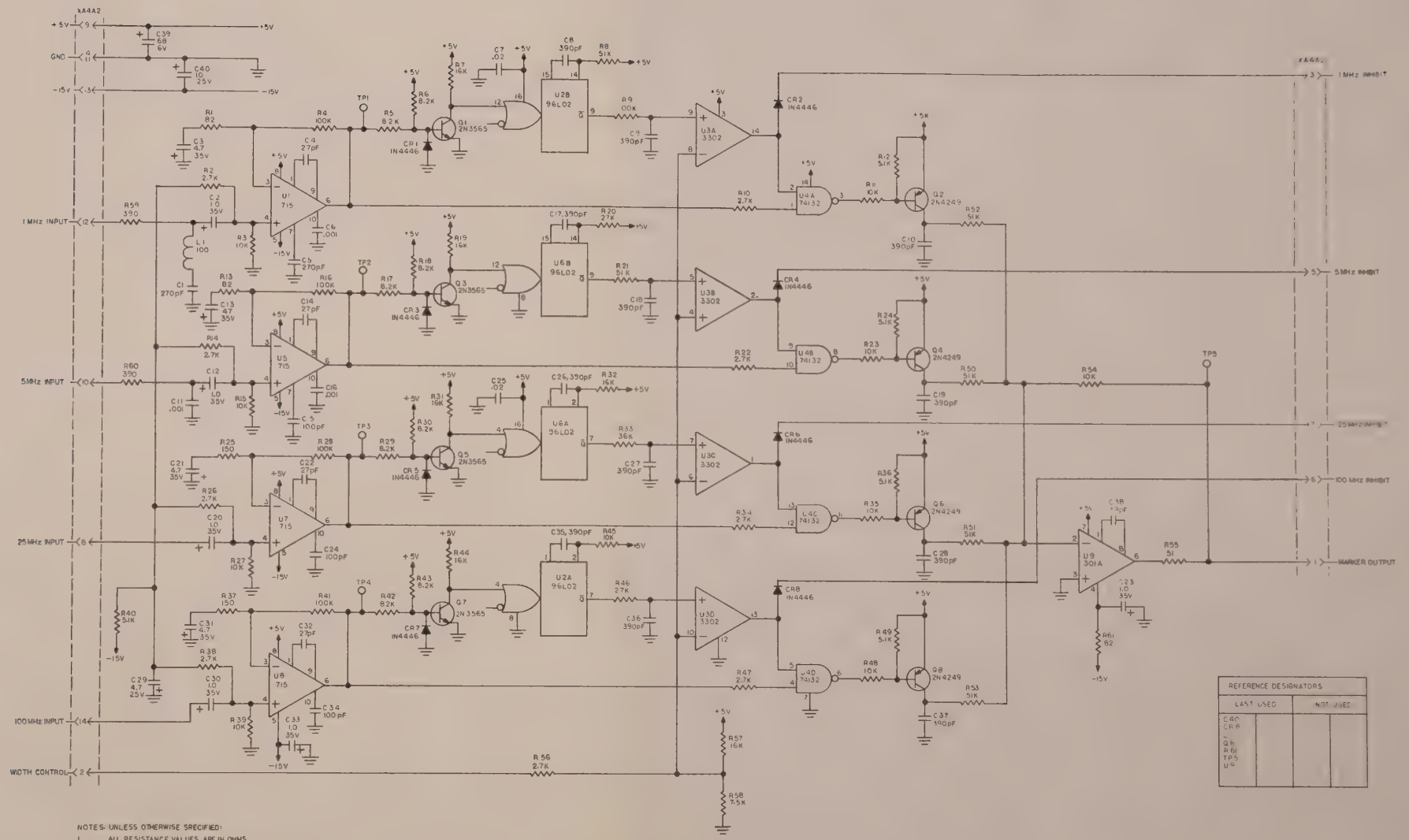


Figure 6-13. Marker Processor Board (640G-A4/1)

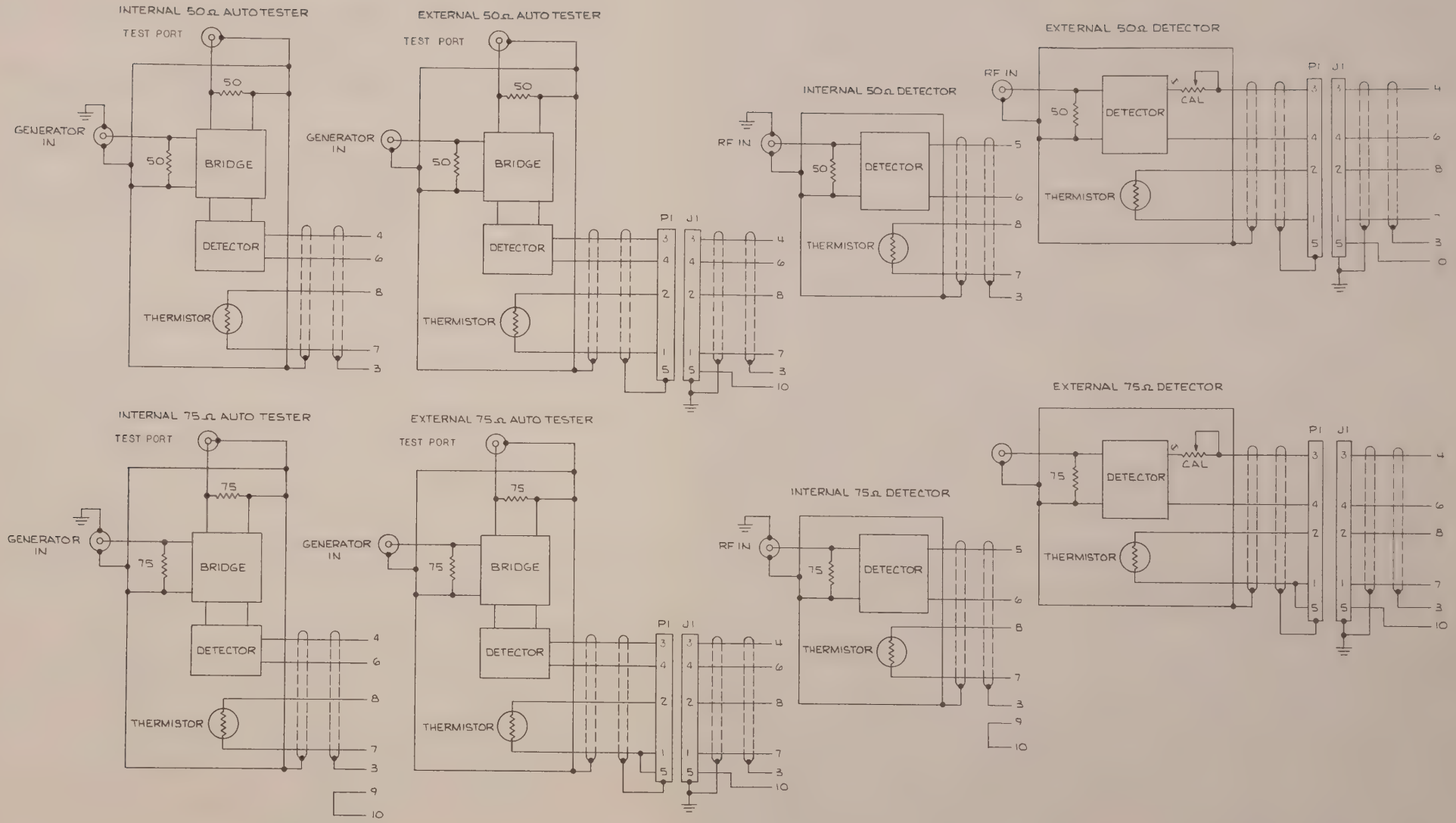


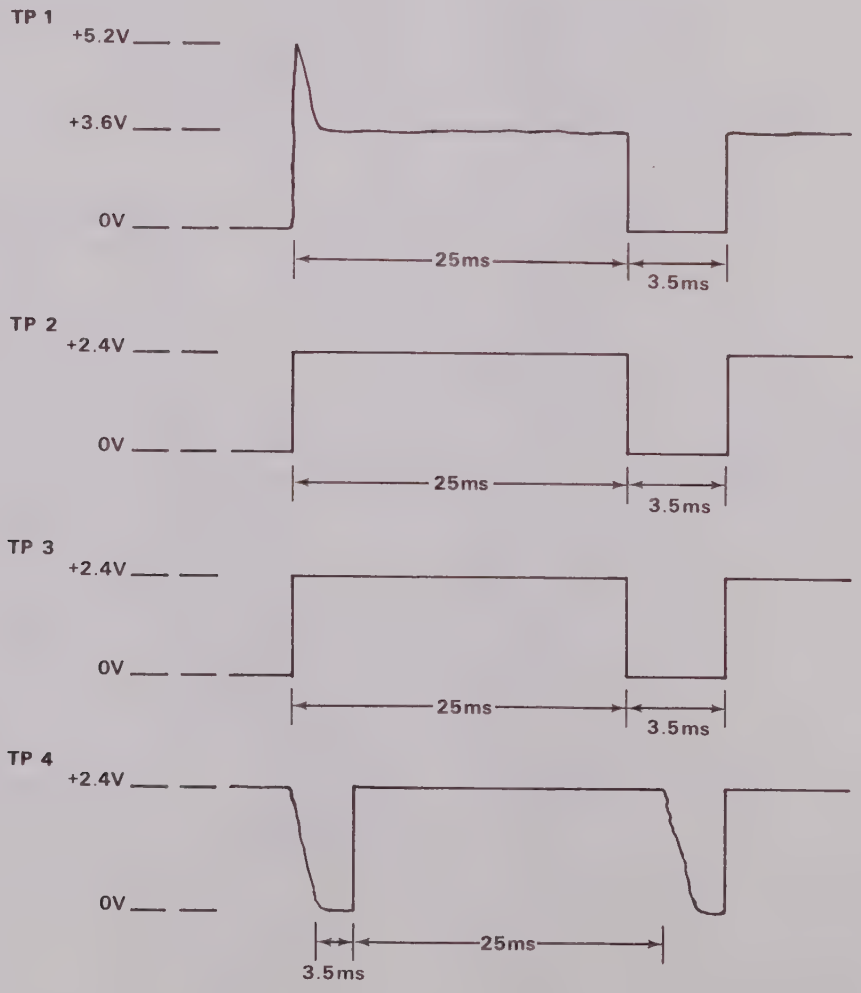
Figure 6-14. Log Plug-In, RF Components (640T, R, E-A1/4)

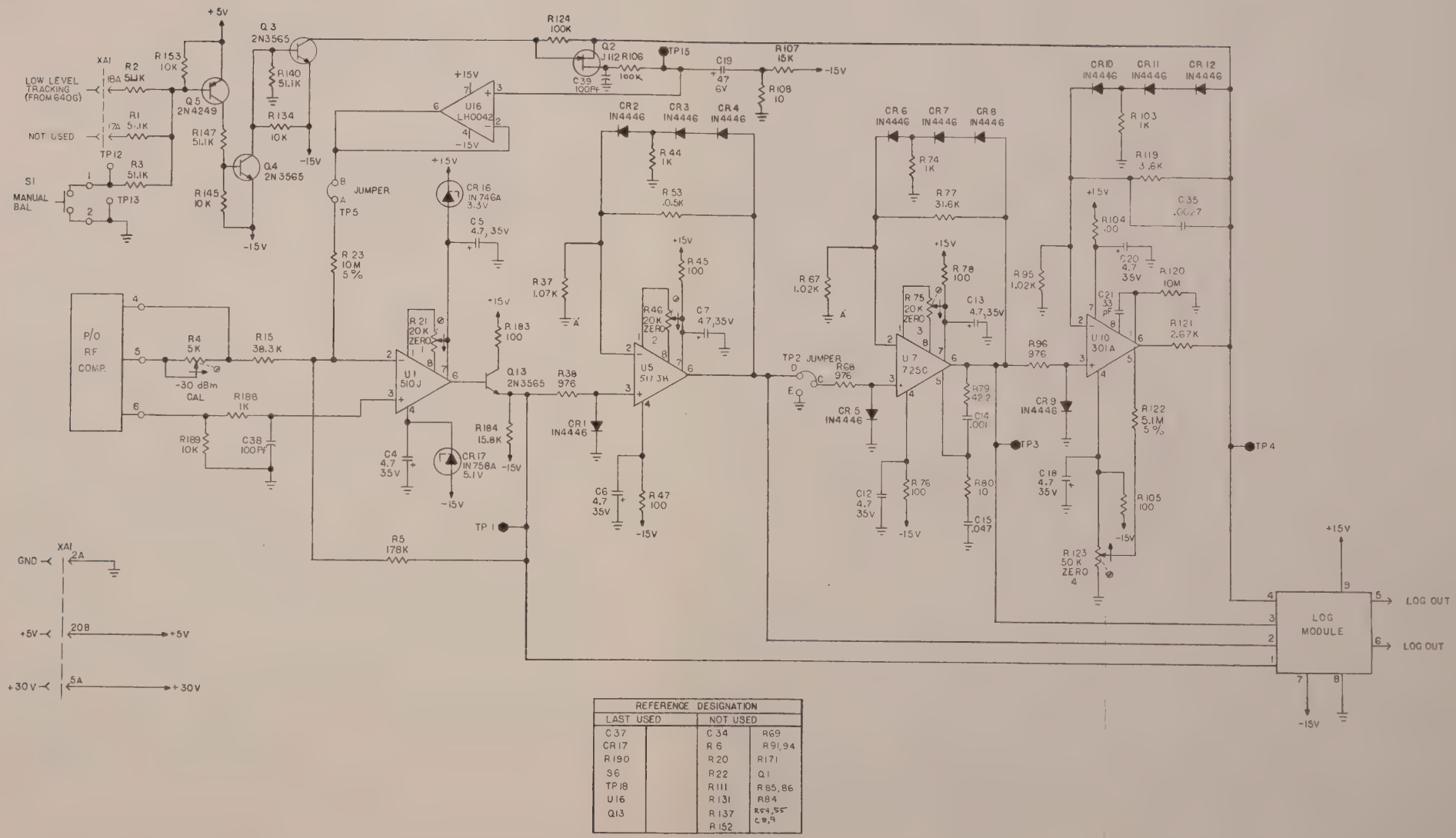
VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		





REFERENCE DESIGNATION			
LAST USED		NOT USED	
C37		C34	R69
CR17		R6	R91,94
R190		R20	R171
S6		R22	Q1
TP18		R111	R85,86
U16		R131	R84
Q13		R137	R54,55 C8,9
		R152	

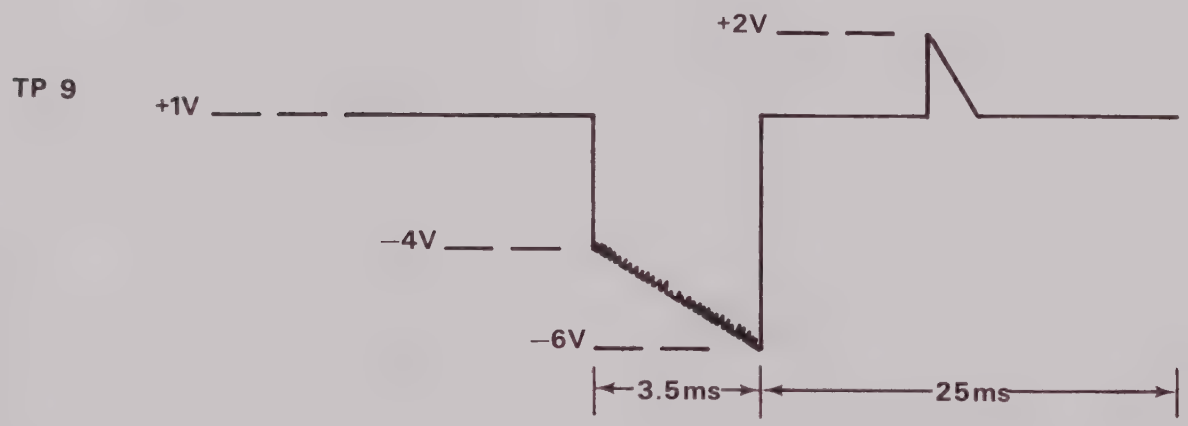
Figure 6-15. Log Plug-In, Preamplifier (640T, R, E-A1/1)

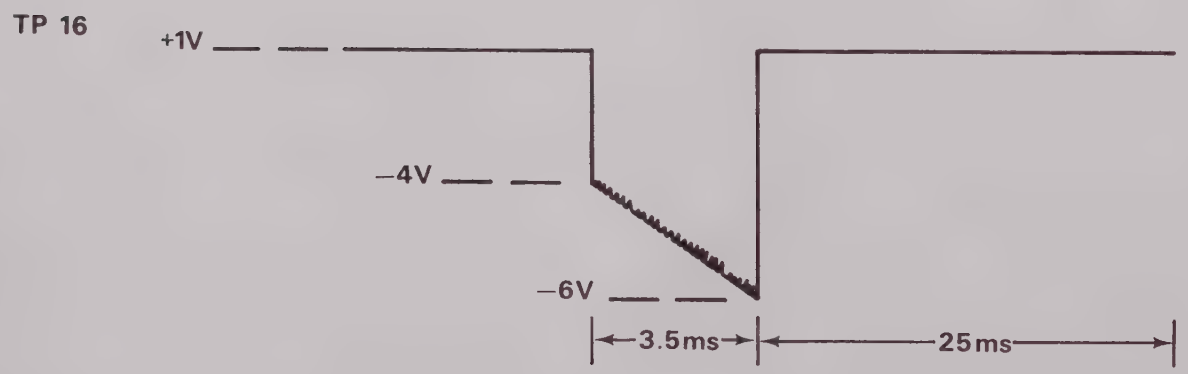
VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		





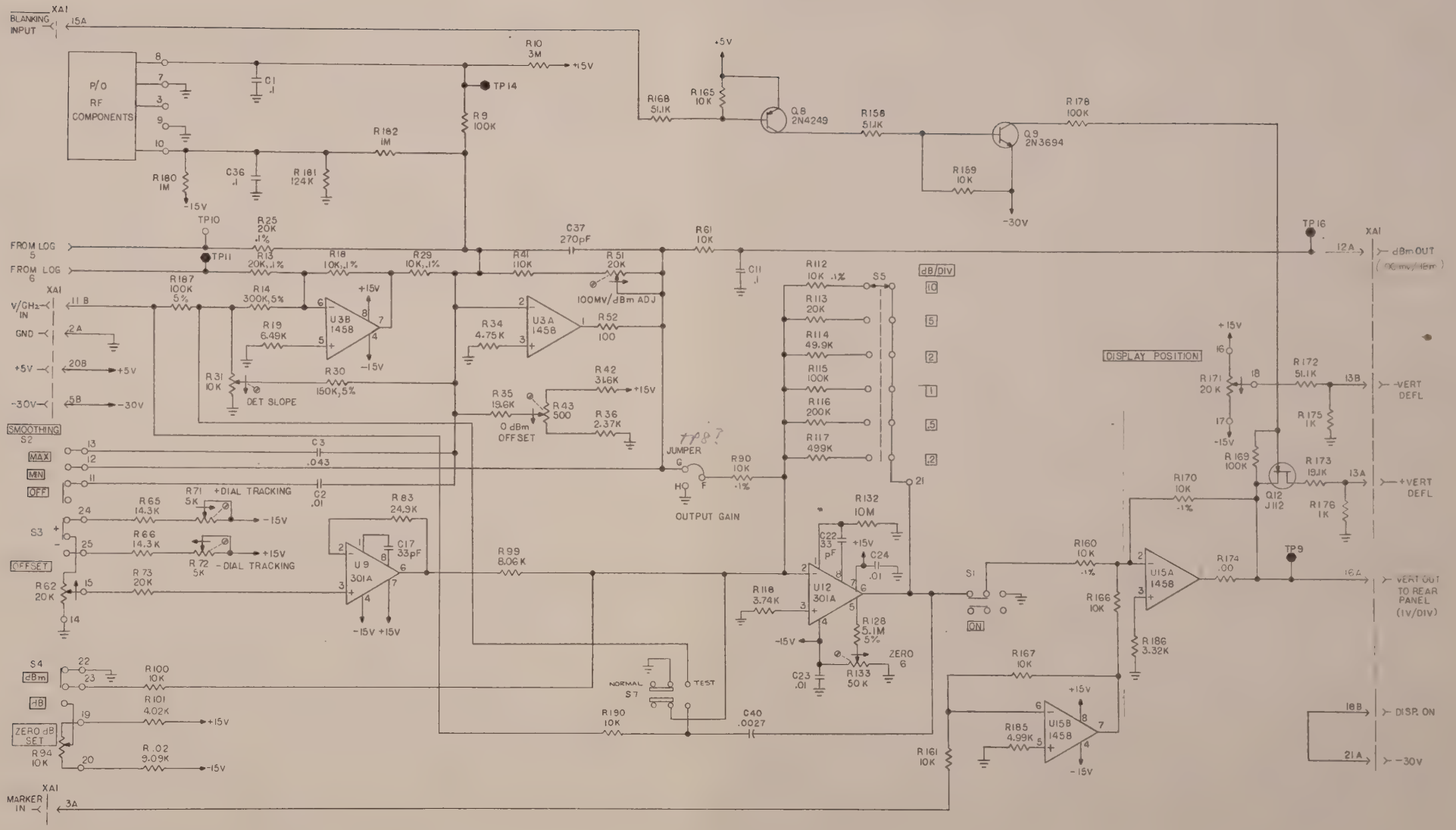


Figure 6-16. Log Plug-In, Processor (640T, R, E-A1/2)

VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Log plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Log Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	00.0
AMPL:	Fully CW	SWEEP RATE:	FAST	dB/DIV:	10
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	SMOOTHING:	OFF
POWER:	Out position	WIDTH VERNIER:	Fully CW		
		TRIGGER:	AUTO		

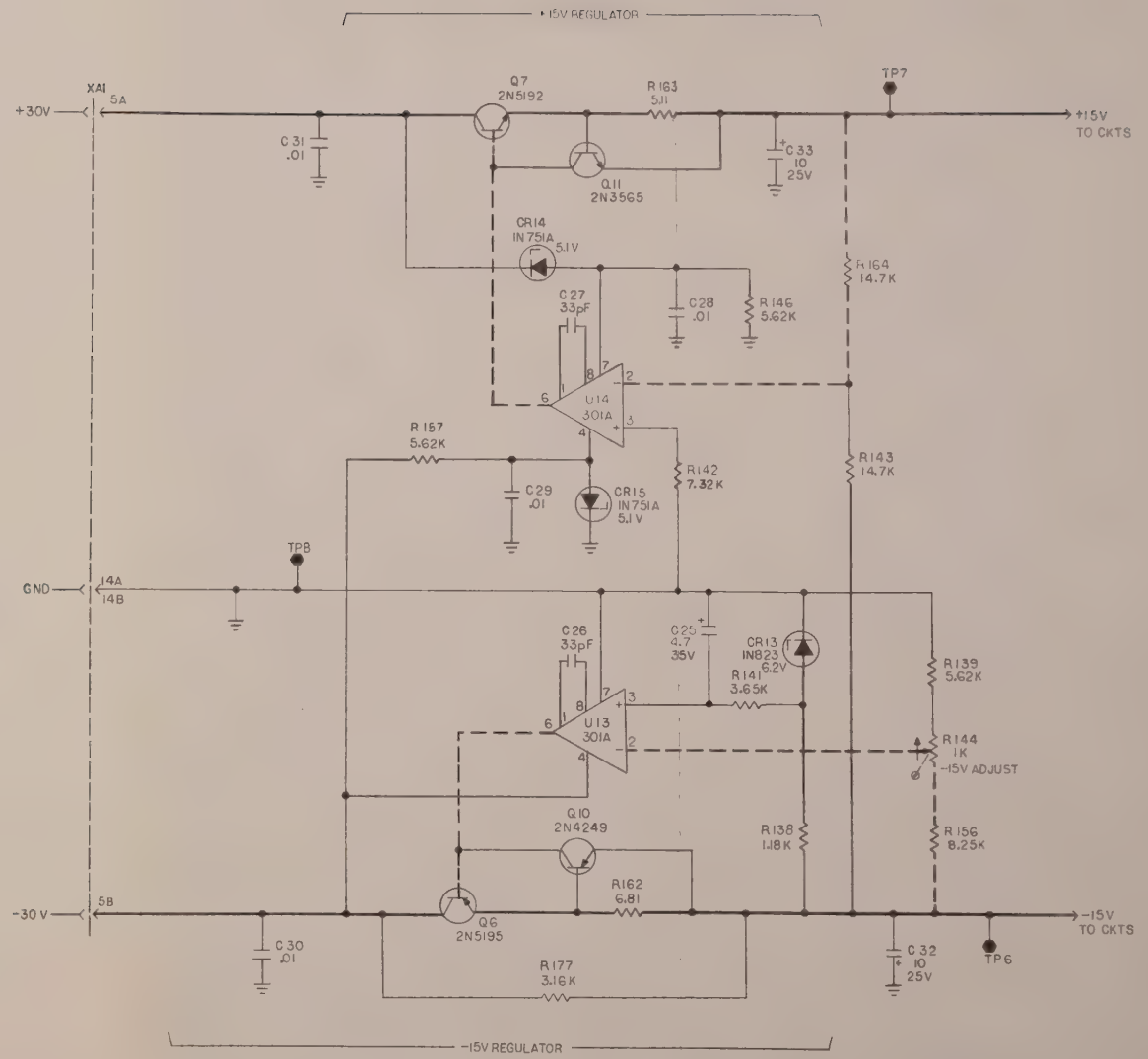


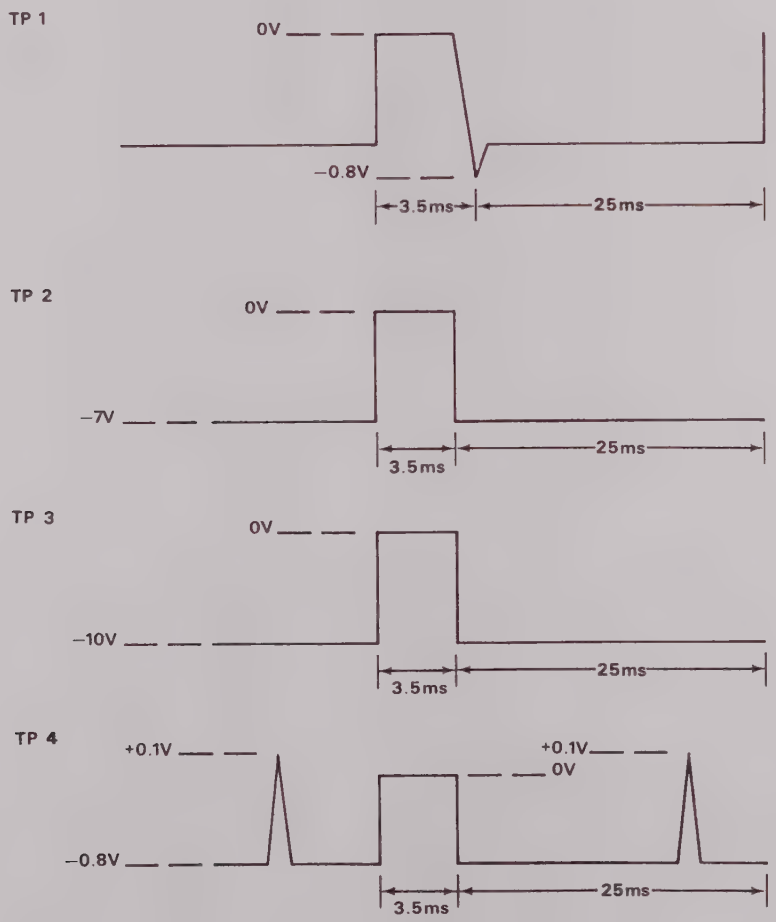
Figure 6-17. Log Plug-In, ±15V Regulators (640T, R, E-A1/3)

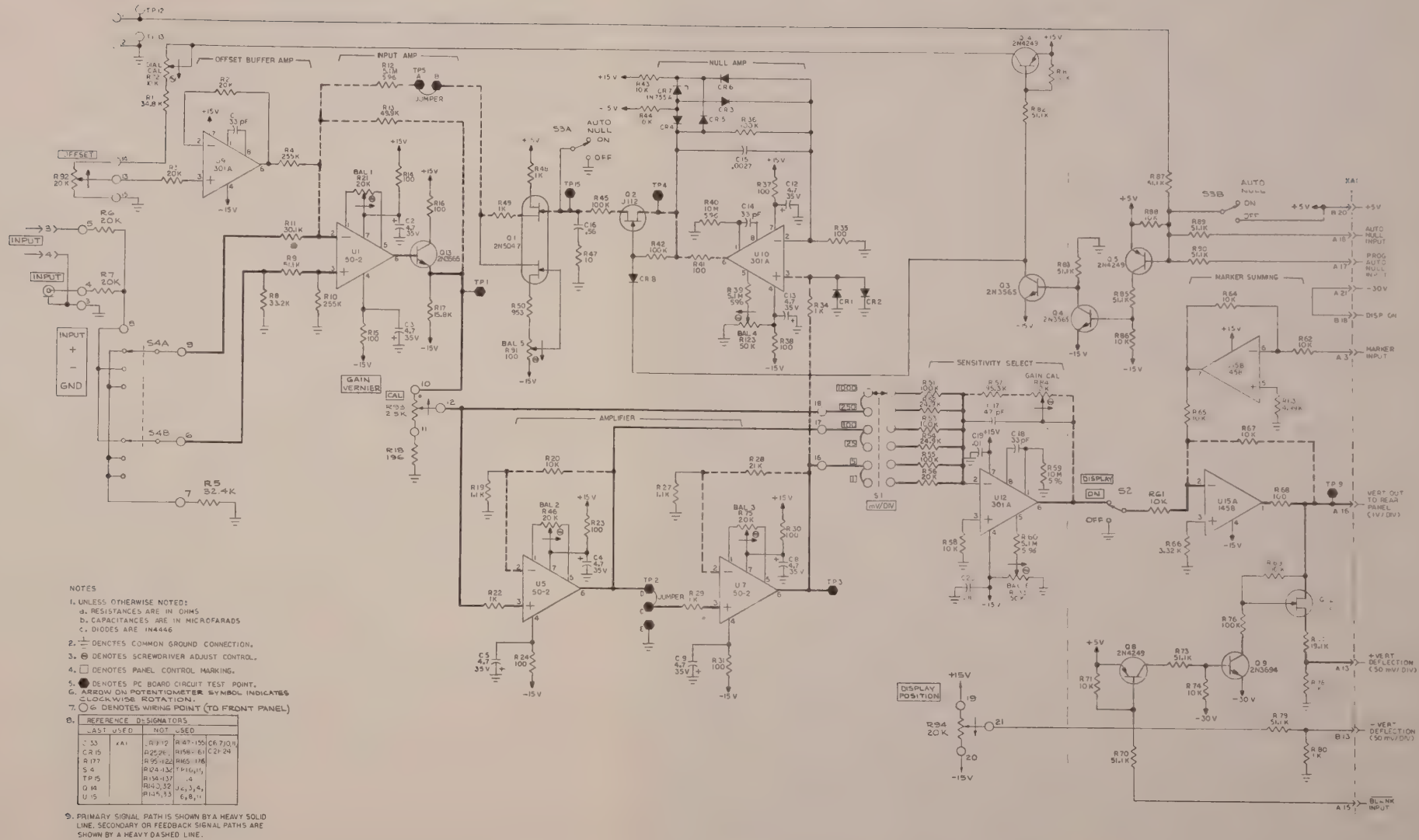
VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Linear plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Linear Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	000
AMPL:	Fully CW	SWEEP RATE:	FAST	mV/DIV:	1000
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	INPUT:	GND
POWER:	Out position	WIDTH VERNIER:	Fully CW	GAIN VERNIER:	Fully CW
		TRIGGER:	AUTO		





NOTES

1. UNLESS OTHERWISE NOTED:
   a. RESISTANCES ARE IN OHMS
   b. CAPACITANCES ARE IN MICROFARADS
   c. DIODES ARE 1N4446
2. ⏚ DENOTES COMMON GROUND CONNECTION.
3. ⊖ DENOTES SCREWDRIVER ADJUST CONTROL.
4. □ DENOTES PANEL CONTROL MARKING.
5. ● DENOTES PC BOARD CIRCUIT TEST POINT.
6. ARROW ON POTENTIOMETER SYMBOL INDICATES CLOCKWISE ROTATION.
7. ○G DENOTES WIRING POINT (TO FRONT PANEL)
8. REFERENCE DESIGNATORS

LAST USED		NOT USED	
C 33	A1	CR1,2	R47-155
CR 15		R25,26,	R158-61
R 177		R95-122	R165-176
S 4		R124-132	TP10,11,
TP 15		R134-137	-4
Q 14		R140,32	U2,3,4,
U 15		R145,33	6,8,11

C67,70,71
C21-24

9. PRIMARY SIGNAL PATH IS SHOWN BY A HEAVY SOLID LINE. SECONDARY OR FEEDBACK SIGNAL PATHS ARE SHOWN BY A HEAVY DASHED LINE.

Figure 6-18. Linear Plug-In, Amplifier (640L-A1/1)

VOLTAGE AND WAVEFORM CONDITIONS

Voltages and waveforms on the diagram are not absolute and may vary from one instrument to another because of component tolerances, calibration or front panel control settings. Measurements were made under the following conditions:

Linear plug-ins were installed in the left and center compartments while a 640G was installed in the right compartment. The front panel control settings are shown below.

640 Mainframe		640G Plug-In		Linear Plug-Ins	
INTENS:	Midrange	SWEEP WIDTH:	FULL	ON:	In position
TILT:	Midrange	MARKER SPACING:	100	OFFSET:	000
AMPL:	Fully CW	SWEEP RATE:	FAST	mV/DIV:	1000
FOCUS:	As desired	SWEEP RATE vernier:	Fully CW	INPUT:	GND
POWER:	Out position	WIDTH VERNIER:	Fully CW	GAIN VERNIER:	Fully CW
		TRIGGER:	AUTO		

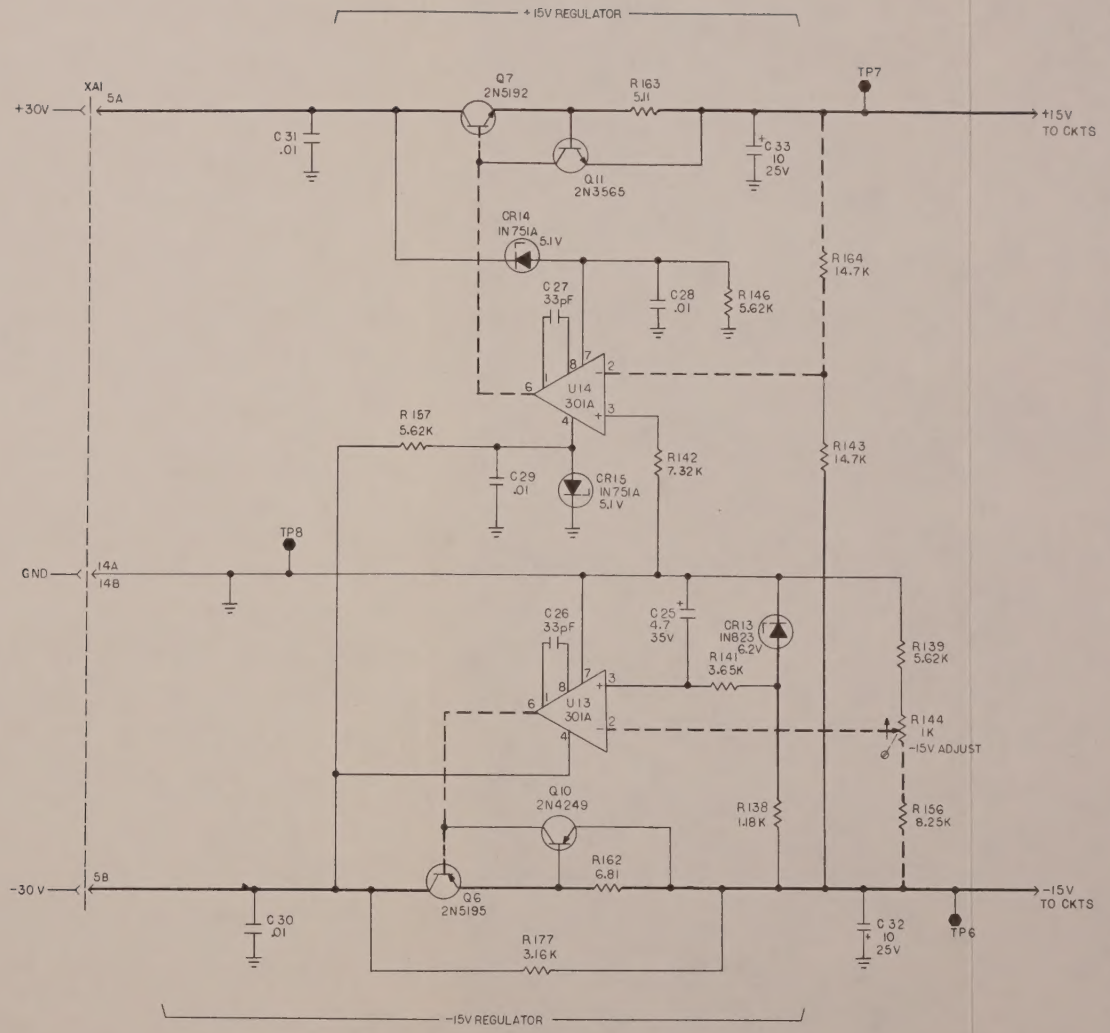


Figure 6-19. Linear Plug-In, ±15V Regulators (640L-A1/2)

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